PARTNERING FOR THE FUTURE:

CALIFORNIA STATE PUBLIC SAFETY RADIO NETWORK

"Public Safety, Public Service" ©

COST BENEFIT ANALYSIS FOR CALIFORNIA'S PUBLIC SAFETY RADIO COMMUNICATIONS PROJECT

April, 1999

The Warner Group
MANAGEMENT CONSULTANTS

STATE OF CALIFORNIA
PUBLIC SAFETY RADIO COMMUNICATIONS
COST BENEFIT ANALYSIS

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Executive Summary

"…the lack of effective and reliable radio communications impedes California's State public safety agencies' ability to perform their basic mission: the protection of life and property."[1]

California's State public safety agencies' radio communications systems are crippled by a lack of interoperability, channel congestion, aging equipment, inadequate funding and limited functionality. Without effective and reliable radio communications, the citizens of California, and those sworn to protect them, are increasingly placed at risk.

Faced with this situation, the State's ten largest public safety departments, together with the Department of General Services, formed a partnership to develop a cohesive, cost-effective strategy for improved public safety communications. This *Cost Benefit Analysis* (CBA) is the result of over five years of intensive planning efforts focusing on the development of the most effective technology and organizational approaches to meet the agencies' combined needs.

PROBLEM STATEMENT

California's State public safety departments are in dire need of improved field communications capabilities. Existing systems fail to meet current user needs and are unable

[1] This statement was the foundation for Partnering for the Future: *A Strategic Plan for California's Public Safety Radio Communications System*, January 1997, prepared by the State's Public Safety Radio Strategic Planning Committee.

to support future requirements. These aging systems are increasingly jeopardizing the safety of both citizens and field personnel. Current problems are summarized below:

Lack of Interoperability

State public safety departments lack the ability to communicate effectively with each other and with federal and local public safety agencies. Currently, California's public safety departments operate in every available frequency band allocated for public safety use. Radio users in one band cannot talk to users operating on a different band. As a result, communication among state agencies, and sometimes among different divisions within the same department, can be severely restricted. The increasing complexity, size and frequency of disasters and emergency incidents are escalating the requirements for coordinated multi-agency response among different levels of government.

The safety of field personnel is increasingly jeopardized

For example, in Yuba County, Sheriff's Department personnel, local Search and Rescue (SAR) and Urban Search And Rescue (USAR) teams, State Fish and Game, local fire and the California Department of Forestry (CDF) all required mutual aid communications during the recent floods in 1997. Coordinating these search operations required three separate radios. Some of the teams went into the flooded areas on assignment without communications with the Command Post, potentially losing their lifeline. The lack of direct communications capability also caused multiple teams to search the same submerged houses, delaying response to other citizens in need, and putting State personnel into unnecessary hazardous situations.

On November 29, 1991 California Highway Patrol (CHP) assumed full command of a multi-vehicle fatality accident that occurred near Fresno on Interstate 5. Very high winds blowing loose dirt from the adjacent fields created a low visibility situation on the roadway, which resulted in an enormous accident. The accident scene consisted of 33 collisions including a total of 164 vehicles and 349 people; the final accounting was 151 persons injured and 17 persons killed. Eventually, over 20 agencies participated in clearing this incident, including the California Department of Transportation, CDF, several emergency medical services, both

public and private, and all local law enforcement. The lack of interoperability among the participants severely hampered their ability to communicate quickly and clearly, resulting in delays in responding to the accident victims.

The lack of interoperability severely hampers public safety response

In the spring of 1992 the acquittal of the officers involved in the Rodney King trial in Los Angeles provided the impetus for one of the most serious, destructive, and dangerous civil disturbances of recent memory. It constituted the extreme example of another type of occurrence that required the essential services and coordination of many agencies in a very fluid situation. Effective response by law enforcement, fire and emergency medical personnel was severely impacted in this situation due to the lack of effective radio communications.

Channel Congestion

Congestion on existing voice radio systems often leaves field personnel waiting several minutes to access an available channel. California's public safety departments are currently operating near, and in some cases exceeding capacity of their existing radio communications systems. Radio spectrum allocated for public safety, in the VHF, UHF, and 800 MHz bands, has been fully assigned in most urban areas of California; there are no additional channels currently available.

When the nations' worst firestorm in almost a century raged in Berkeley and Oakland Hills in 1991, firefighters from more than 50 federal, state and local agencies joined to battle the blazes. At the height of the fires, radio communications was often impossible. Congestion caused by too many radio units on the same few available channels jammed communications. As a result, communications among cooperating agencies was often limited to face-to-face interaction. The Oakland Hills fire took 25 lives, injured 150, destroyed 3,000 homes and exceeded $1 billion in losses.

Aging Equipment

Antiquated systems and aging equipment inventories translates into escalating maintenance costs and reduced reliability. The majority of the State's existing radio communications systems rely on 30-year old technology. Much of the infrastructure was installed over ten

years ago, and over 50 percent of the State's 43,000 user radios are at or nearing the end of their useful life.

The California Highway Patrol's existing radio communications system is facing imminent obsolescence. The Department can no longer obtain radio equipment from major manufacturers. The loss of vendor support will impact the ability to provide even the most basic radio communications between officers and dispatchers in the next few years.

Limited Functionality

The lack of commonly available mobile data communications and video transmission capabilities in the field significantly impairs the effectiveness and safety of public safety personnel during routine and disaster situations. Advances in field data, remote sensors, and video communications technologies are providing a wealth of new capabilities and applications that can substantially aid public safety personnel in performing their duties.

On January 17, 1994, one of the nation's most damaging earthquakes since 1906 hit the San Fernando Valley. The most significant incident, in terms of loss of life, associated with this catastrophe, occurred when a three story, 120-unit apartment complex collapsed. Involved in the rescue operations were Urban Search and Rescue teams from several counties and the Governor's Office of Emergency Services. Advanced field communications technologies could have aided this and similar efforts in the affected areas by making floor plans, resource lists, damage assessments and other critical information instantly available on-scene. As the obsolescence of radio communications systems across the State continues for the majority of agencies, the safety of field personnel and their ability to provide service to the public during emergency and routine operations is increasingly jeopardized.

Limited features hamper public safety operations

Narrow Window of Opportunity

The Federal Communications Commission (FCC) recently completed proceedings that outline the approach for the newest public safety spectrum allocation. This spectrum allocation, in the 746 – 806 MHz band, previously Television Channels 60 – 69, will alleviate some channel congestion problems for agencies that have the resources and

organization to rapidly pursue licensing. Spectrum is a desperately needed resource that is licensed on a first-come, first-served basis. The licensing process favors agencies that can prove cooperative use of the requested frequencies, show the financial resources necessary to implement shared systems, and demonstrate the organizational structure to fairly govern the spectrum's use. The State must position itself to take advantage of this most recent, as well as other potential spectrum, allocations.

BACKGROUND

California's public safety departments provide a wide range of public services including law enforcement, fire protection, disaster response, transportation management, flood control, criminal detention and rehabilitation, search and rescue, and other services to over 32 million residents and 44 million visitors to the State each year. In order to effectively and responsively provide these services, the State's public safety departments require immediate field access to information such as wants and warrants, vehicle registration, weather, terrain access, missing persons, and gun registration. For the over 43,000 State public safety employees involved with field operations, mobile radio communications is the primary, and sometimes only link to this information and additional resources during both routine and emergency operations.

Radio communications is often the only link to safety for over 43,000 State employees

Recognizing the need to improve the existing radio systems and to enhance functionality and interoperability, the Public Safety Radio Strategic Planning Committee was established in December 1994. The Committee's goal was to develop a vision for public safety radio communications, built upon collaborative efforts and shared successes.

The ten State departments that have joined together as the Public Safety Radio Strategic Planning Committee include:

- Department of California Highway Patrol
- Department of Corrections
- Department of Fish and Game
- Department of Forestry and Fire Protection
- Department of Justice
- Department of Parks and Recreation
- Department of Transportation
- Department of Water Resources

- Department of the Youth Authority
- Governor's Office of Emergency Services

An additional key stakeholder of the State is the Department of General Services, which is responsible for developing and maintaining the systems to meet the needs of the agencies.

To facilitate the accomplishment of it's goals, the State of California engaged consultants to assess the State's current radio communications systems, evaluate existing and emerging technologies and guide the Departments in the preparation and delivery of a strategic plan. *Partnering for the Future: A Strategic Plan for California's Public Safety Radio Communications* was published in January 1997.

The Strategic Plan established the vision for a new infrastructure

One of the first steps towards the implementation of the Strategic Plan is to complete this Cost Benefit Analysis (CBA). The CBA contains the requirements for the radio systems, an analysis of the alternatives, including preliminary costs and associated benefits, a conceptual model of the proposed systems design, and an implementation plan outlining the required steps and timetable to proceed.

The CBA analysis focuses on three primary alternatives for meeting the collective agencies needs for field voice and data communications:

1. ***Maintain Status Quo*** – This assumes maintaining the existing systems, and making no further investments in capital improvements to the systems.

2. ***Pursue Agency Independent Initiatives –*** This alternative assumes that the State departments would pursue the acquisition of systems that would support their unique needs. They would do so independent of what other departments may or may not be doing to enhance their own communications systems.

3. ***Pursue Shared Infrastructure*** – This alternative assumes that the State departments would pursue the acquisition of a shared radio infrastructure to support their unique needs in partnership with other State departments.

RECOMMENDATION

The development of a shared radio system infrastructure by the State public safety agencies offers the best opportunity to address department communications needs and to improve interoperability, both for day-to-day operations and emergency response situations.

Shared systems will most cost effectively meet the State's needs

A shared infrastructure approach is the most cost-effective means of obtaining enhanced system functionality and the most effective way of pursuing new spectrum allocations. This proposed solution is based upon the conclusions reached in the detailed analysis of the available alternatives. The foundation for this recommendation is based upon the following conclusions:

- ***The State cannot maintain the status quo*** – Technology changes, resulting in manufacturers no longer supporting equipment in certain portions of the spectrum, and federal mandates, such as narrow-band spacing requirements, will not allow continued use of current baseline technologies. Without a major replacement of the existing systems, radio communications will be severely compromised. This condition will continue to place the citizens of California, and those sworn to protect them, at risk.

- ***The State cannot afford the development of independent systems*** – Although the development of independent systems by the State departments would address many needs, it will cost significantly more than the implementation of a shared infrastructure. In addition, this independent approach does not enhance critically needed interoperability nor does it promote operational efficiencies. The departments also will have difficulty acquiring additional spectrum from the FCC (which is requiring more shared systems) to alleviate channel congestion.

The implementation of a shared, statewide, public safety radio communications infrastructure should be designed based on the following criteria:

- Hybrid of voice and data networks to meet geographic and operational needs
- System design and optimization to meet agency-unique operational requirements
- Use of digital technologies for improved operational capabilities, security and spectrum efficiency
- Operation in multiple spectrum bands, utilizing modern switching technologies, to maximize cost effectiveness and operations
- Use of existing facilities and equipment to the maximum extent possible, reducing overall costs

Based on a detailed analysis of the various technology and spectrum alternatives, we have concluded that the new system's infrastructure should be developed with a hybrid backbone,

using both VHF and UHF spectrum. This approach maximizes the cost effectiveness of the system by taking into account both the varied terrain of the State and the available spectrum, as well as by leveraging existing systems. Also, by using advanced switching technology, the equipment that routes and connects communications transmissions, the hybrid approach should allow for full interoperability among the system users, enhancing effectiveness and safety. To fully use the serviceable life of existing equipment, departments will migrate to the new infrastructure as their current equipment becomes obsolete and more cost-effective to replace.

BENEFITS

The benefits of developing a shared radio communications infrastructure for the State's public safety agencies are extensive and relate directly to their individual and collective needs and requirements, including:

- ***Increased ability of public safety professionals to accomplish their missions*** – A comprehensive, shared radio communications infrastructure will increase operating efficiencies for all the participating departments. Risks to field personnel decrease as faster access is gained to vital information. State-of-the-art digital and trunking communications systems provide rapid simple access to information and resources that enhance personnel safety and allow the departments to better accomplish their missions. In turn, the public will be better served by public safety personnel who are more effective and productive.

- ***Improved ability to directly interoperate with mutual aid cooperators*** – A shared infrastructure will allow departments to communicate directly with their mutual aid partners without requiring the use of multiple radios or complex technical solutions. Interagency coordination is made easier by a reduction in equipment, and information is more easily transferred in a direct fashion with fewer errors and delays. By enabling direct interoperability among participating departments, the public will receive better, and more timely, coordination of public safety services.

- ***Faster, more accurate access to information*** - The shared data system promotes the rapid, direct transfer of information to personnel in the field and among departments. Direct data access removes the potential for errors in verbal transmission. This direct information transfer promotes greater safety and operating efficiencies, thereby increasing timely service levels to all those supported by the participating departments.

- ***Ability to support continued system growth through the deployment of mobile data –*** As the number of radio users increases, there will be more and more demand for voice communications channels. Using a mobile data system will provide more capability for voice communications by moving routine data traffic onto a more efficient medium (digital data transmission).

- ***Ability to reduce channel congestion*** – By combining operations onto an integrated infrastructure, State radio users will enjoy the benefits of operating in a trunked environment, where access to channels is improved. Trunking helps reduce channel congestion by providing the ability to dynamically manage channel resources while maintaining operational separation among user departments.

- ***Improved cost effectiveness*** – The development of a shared infrastructure will reduce the amount of required facilities and equipment, resulting in significant cost savings. It will also result in a reduction in spare parts inventories and the types of equipment requiring service. By reducing the types of equipment requiring maintenance, the overall training required for maintenance providers will decrease. Thus, the cost associated with supporting a qualified maintenance force will be reduced. Consolidation of sites means fewer trips to separate locations, improving the use of this staff.

In summary, by implementing shared radio infrastructures, the State will improve its public safety departments' ability to serve citizens and visitors.

COSTS

The State should save over $795 million by migrating to shared systems

The State of California's public safety agencies are in a critical situation with failing radio communications systems that do not meet user needs. In order to correct this situation, the State must invest approximately $3.504 billion over the next fifteen years on a new wireless voice and data communications infrastructure, user equipment and maintenance services. If the State chooses to ignore the opportunity to improve public safety communications in a cohesive, shared manner, individual departments will proceed with independent system improvements. If this independent approach is followed, it is estimated that the State will invest over $4.299 billion during the same 15 year period, resulting in excess expenditures of over $795 million compared to the development of a shared system.

Savings should be realized through reductions in site development, fixed-site equipment, site-to-site links, maintenance requirements, as well as system design, engineering and development. In addition to the system savings, other benefits include improved functionality and universal coverage for agencies that could not afford such system improvements on their own.

The following table shows a summary of the estimated one-time and recurring costs associated with the development of a statewide, shared, public safety radio communications infrastructure. One-time costs consist of the costs associated with the purchase of both backbone and user equipment (voice and data), as well as the costs associated with system implementation, installation, integration, training, and contingency planning. The recurring costs are those cost components associated with ongoing system maintenance, ongoing site costs such as leases, and ongoing site connectivity costs such as telephone line or microwave services.

ITEM	ESTIMATED COSTS
TOTAL ONE-TIME COSTS	***$2,110,701,000***
TOTAL 15 YEAR RECURRING COSTS	***$1,392,844,000***
15 YEAR TOTAL	***$3,503,545,000***

These cost estimates are based on a collaboration of two independent efforts conducted to secure the most reliable information for such a large and complex system. The first effort was based upon a study of existing State and county systems to determine the optimum number of required sites necessary to meet the border-to-border coverage needs of the State's public safety departments. By reviewing these current systems and their current spectrum use, an analysis was completed to estimate the number of sites required to establish comprehensive coverage capabilities throughout the state.

The second effort involved extensive computerized modeling, undertaken by the Department of General Services, to determine the number of required sites throughout the state. The modeling results were compared to a sample of existing systems throughout the State for validation purposes. This engineering approach yielded a more refined estimate of the required infrastructure design and resulting costs.

Together, the two approaches to estimating the number of required sites resulted in similar findings regarding the required infrastructure to develop a new shared radio system throughout the State. Based on the number of required sites, detailed equipment and services cost estimates were prepared for the different alternative approaches. In each case, one-time and recurring costs over a fifteen-year period were estimated.

It must be stressed that these cost estimates are for initial budgeting purposes. They are based upon an overall design that could change with further detailed engineering analysis and optimization of service level requirements. The actual spectrum ranges and technologies deployed for the system will also impact the cost estimates.

IMMEDIATE NEXT STEPS

This CBA document provides the State with the foundation to begin the development of the improved public safety radio infrastructure. Several immediate next steps are required to further the project development.

The State should immediately begin the development and implementation of pilot projects. Pilot projects can serve to demonstrate proof of concept for technical, fiscal and operational challenges. The proposed system design and resulting cost estimates will be further validated and refined. This validation process is critical to accomplish prior to securing the necessary funding for the entire project.

The State should immediately implement pilot projects

Pilot projects will also assist the State with one of the other critical next steps in the project: securing the necessary radio spectrum. The State is currently faced with a narrow window of opportunity to acquire desperately needed radio spectrum. Increasing competition for spectrum, new regulations governing wireless communications and rapidly changing technologies are impacting the State's ability to provide reliable public safety radio communications. It is imperative that the State move quickly and decisively with the Federal Communication Commission (FCC) to identify and acquire the necessary spectrum. When an organization can show proof of commitment and financial resources to implement the

project, the FCC is more inclined to grant frequency licenses to support the implementation. By moving forward with the pilot projects, the State will demonstrate its commitment to begin the implementation of a shared public safety radio system.

* * * * *

The State of California public safety agencies have a critical and compelling need for improved radio communications. This cost benefit analysis represents a significant milestone in the effort to develop a new radio communications infrastructure to meet the collective needs of the State's public safety agencies. Over five years of effort have gone into the development and refinement of the long-term vision contained in this report. The State must move forward into the next phases of the project, and rapidly deploy pilot projects to validate the project concepts and secure the necessary spectrum. Without an improved radio communications infrastructure, the citizens of the State of California and those sworn to protect them will continue to be placed at risk.

SECTION I

REQUIREMENTS

THE WARNER GROUP

A. INTRODUCTION

"…the lack of effective and reliable radio communications impedes California's State public safety agencies' ability to perform their basic mission: the protection of life and property."[1]

Each of California's State public safety agencies currently operates and maintains largely independent radio communications systems. These systems, however, are crippled by the lack of interoperability, channel congestion, aging equipment, inadequate funding and limited functionality. Without effective and reliable radio communications, the citizens of California, and those sworn to protect them, are placed at risk.

Significant investments in wireless technology are required to rescue California's deteriorating public safety radio communications systems, and to meet citizen needs for improved protection and safety. At the same time, Californians expect government to operate more efficiently. If the State public safety agencies individually develop improved radio communications systems, it will result in an estimated investment of $4.299 billion over the next 15 years. These individual actions, however, will not meet all the needs for improved public safety communications.

After years of filings from public safety agencies, the Federal Communications Commission (FCC) in its Second Notice of Proposed Rulemaking (FCC 97-373 10/97) recognized public safety needs and has developed "goals for establishing a plan to ensure … spectrum to meet critical public safety communications needs." The Rulemaking further states: "Every public safety officer should have access to a communications system that is reliable, of high quality and allows him or her to communicate with colleagues in other jurisdictions or from other agencies during emergencies as well as on a day-to-day basis."

[1] This statement was the foundation for Partnering for the Future: *A Strategic Plan for California's Public Safety Radio Communications System*, January 1997, prepared by the State's Public Safety Radio Strategic Planning Committee.

The FCC-proposed spectrum release presents California's public safety agencies with a rare window of opportunity which, due to the plan developed by the Public Safety Radio Communications Strategic Planning Committee, the State is positioned to take advantage of. California must, however, move quickly and decisively to gain even a portion of this spectrum for which competition is historically fierce. A partnership among the State public safety agencies, with coordinated investments in shared public safety radio communications systems, will result in a more effective and cost efficient method of meeting the State's long term communications needs.

B. BACKGROUND

California's public safety agencies provide a wide range of public services including law enforcement, fire protection, disaster response, transportation management, flood control, criminal detention and rehabilitation, search and rescue, and other services to over 32 million residents and 44 million visitors to the State each year. In order to effectively and responsively provide these services, the State's public safety agencies require immediate field access to information such as wants and warrants, vehicle registration, weather, terrain access, missing persons, and gun registration. For the over 43,000 State public safety employees involved with field operations, mobile radio communications is the primary, and sometimes only link to this information and additional resources during both routine and emergency operations.

The State of California public safety agencies have used mobile radio communications systems to provide safety to the public for over 50 years. The California Highway Patrol (CHP), the Department of Transportation (DOT), the California Department of Forestry (CDF), and other agencies, have developed and maintained their own systems and capabilities. This separate development process has resulted in an environment of disparate systems that are expensive to operate and do not provide the necessary functionality to meet today's needs. One of the primary needs not fully addressed is interoperability, which is the ability to communicate directly between users and agencies who operate disparate systems.

Recognizing the need to improve the existing radio systems and to enhance functionality and interoperability, the Public Safety Radio Strategic Planning Committee was established in

December, 1994. The Committee's goal was to develop a vision for public safety radio communications, built upon collaborative efforts and shared successes.

The ten State agencies that have joined together as the Public Safety Radio Strategic Planning Committee include:

- Department of California Highway Patrol
- Department of Corrections
- Department of Fish and Game
- Department of Forestry and Fire Protection
- Department of Justice
- Department of Parks and Recreation
- Department of Transportation
- Department of Water Resources
- Department of the Youth Authority
- Governor's Office of Emergency Services

An additional key stakeholder of the State is the Department of General Services, which is responsible for developing and maintaining the systems to meet the needs of the agencies.

To facilitate the accomplishment of it's goals, the State of California engaged consultants to aid in the preparation and delivery of a strategic plan which would contain the following: 1) the identification and inventory of current systems and capabilities; 2) a description of needs and requirements; 3) a review of the technical and organizational alternatives; 4) a cost analysis which would forecast the one-time and recurring costs of the alternatives; and 5) recommendations for achieving the agencies' vision of cooperative, shared communications systems. *Partnering for the Future: A Strategic Plan for California's Public Safety Radio Communications* was published in January, 1997.

The first step towards the implementation of the Strategic Plan is to complete this detailed Cost Benefit Analysis (CBA). The CBA contains the requirements for the radio systems, an analysis of the various alternatives including costs and benefits, a conceptual model of the proposed system design, and an implementation plan outlining the required steps and timetable to proceed with the improvements.

Current Environment

Since the development of the existing radio systems that serve the State's public safety agencies, many changes have occurred within the wireless communications environment that impact the future direction of these systems. Changes include a significant increase in the competition for radio spectrum resources, new regulations governing wireless

communications, rapidly changing technologies, a high level of growth in population, and increasing demands at the local level. Below is a discussion of each of these changes:

Competition for Spectrum **-** With the revolution in information technology over the last 15 years, the demand for radio spectrum has exploded. Organizations competing with the public sector for spectrum allocations include cellular telephone companies, television broadcasters, personal communications services (PCS) providers and others. These organizations have spent billions of dollars in recent years in spectrum auctions, making it problematic for public safety agencies who hold less than ten percent of the licenses and are not able to compete financially.

For over twenty-five years California public safety agencies have struggled to obtain adequate spectrum allocations to meet their needs. In 1983, the California State Legislature held hearings and notified the FCC of the need for contiguous spectrum allocations for public safety (SJR 60). In the late 1980's, the FCC released the most recent allocation of spectrum for public safety in the 800 MHz range. The demand for this spectrum by public safety agencies has far exceeded availability. In southern California alone, there were over 400 applications, with multiple channel requests per application, for the 240 new channels. The State was almost completely shut out of this new spectrum due to a lack of funding for the construction of the systems and an inability to commit the necessary resources to use the channels.

In response to the needs of public safety, the FCC is currently considering the allocation of additional spectrum. While this is a positive move by the FCC, it would likely further segregate public safety users because it is not contiguous with most current allocations. Although there still are many open issues and questions about how this allocation will impact California, it is considered an historical moment of opportunity for public safety users.

Regulatory **-** The increasing demand for radio spectrum has led the FCC to undertake several initiatives aimed at achieving more efficient use of existing resources. Spectrum efficiencies, however, require new technologies and compliance with the associated federal mandates regulating the design of new communications systems. In February 1995, the FCC issued the Refarming Report and Order with the intent to narrow existing radio channels, thus creating space between the channels and making it available for new allocations. This initiative requires that each Department will have to reconfigure its current system at a minimum, and potentially replace its current system. To date, these efforts by the FCC have done little to alleviate the problems that exist for public safety in California.

Technology **-** As manufacturers develop new technologies, existing systems become outdated and support is discontinued. This is evident in California where the CHP and other agencies currently operate with equipment that is no longer produced or supported. A wide range of mobile radio communications products and services will be introduced as wireless technologies continue to dramatically reshape the communications and information infrastructure of California and the United States.

Advancements in technology now make it feasible for agencies to *share* the development of wireless communications systems, while retaining independent operational capabilities.

High Growth - The Department of Finance estimates that California's population will increase by over 19 million people to 51 million people within the next 25 years. This will significantly impact California's radio communications requirements. Most citizens immediately recognize the need for more roads, schools, and housing to accommodate population growth. Other, not so recognizable, requirements include the public safety radio communications systems. These systems must receive sufficient investment to remain capable of meeting citizens' needs and their expectations for immediate access to public safety providers.

With the increase in population will come urbanization of previously inaccessible wild lands. At the same time, many citizens are building in the rural environment, especially in brushy and timbered lands served by State agencies. To provide service in these areas, substantial investments must be made, including expansion of radio communications systems.

Local Agencies - California's counties and cities also are in need of improved public safety radio communications. Throughout the State, public safety agencies require improved field communications at all levels, including local, state and federal. This is particularly important during disaster and emergency operations. The State may be in a position to provide leadership and support to local agencies. Otherwise, the efforts of the local agencies will compete with the State for the same spectrum resources. If the State does not move ahead expeditiously, it will lose the opportunity to develop improved public safety communications at all levels of government. As the State moves forward, systems should be designed to accommodate the needs of both local and federal agencies where practical. Efforts made by the Public Safety Wireless Network (PSWN), the Federal Law Enforcement Wireless Users Group (FLEWUG), and other federal organizations, as well as the ground-breaking work being done in San Diego and Imperial Counties (crossing several layers of government) have paved the way for future cooperation among all levels of government.

Cost Benefit Analysis Scope

The State's public safety communications systems are composed of many elements. Radio systems function throughout the State where and when commercial systems such as cellular telephones do not work. These radio systems are the lifelines that connects over 43,000 of the State's public safety employees to the assistance they require during emergency and disaster situations. These public safety communications systems are composed primarily of *radio system components*, which provide communications between field personnel and dispatch centers. In addition, there are *ancillary system components*, such as facilities and

computer aided dispatch systems, that support public safety applications and allow providers to perform their missions. These two components are equally important for timely and reliable access to and transfer of information from the field.

This CBA focuses primarily on the radio system components. The ancillary system components are identified to emphasize the consideration of the broader overall requirements for public safety and public service communications. The participating agencies maintain ongoing projects to enhance and improve these ancillary systems.

A visual representation of the demarcation between these radio and ancillary systems components is shown in Exhibit I-1. The following provides a list of the components that are considered part of the overall public safety wireless communications system and equipment.

Radio System Components

- Radio transmitters and receivers
- User radios (mobiles and portables)
- Dispatch console electronics
- Voice and data network controllers
- Microwave backbone system
- Mobile data user devices
- Automatic vehicle location
- 24 hour logging recorders
- Instant recall recorders
- Satellite up-link/down-link equipment
- Satellite transport
- Equipment installation
- Frequency licensing and spectrum acquisition
- Leased radio equipment
- Leased telephone lines and microwave circuits
- Commercial provider "air time"
- Radio sites including vaults and towers
- Site acquisition
- Remote site monitoring
- Radio site leases
- Site modifications or replacement
- Environmental Impact Report/ California Environmental Quality Assurance site studies
- Repair and maintenance

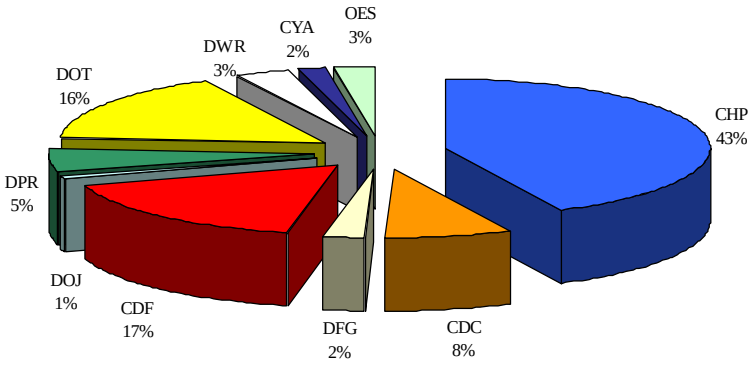
Ancillary System Components

- 9-1-1 telephone systems
- Business and administrative telephone systems
- Freeway call boxes
- Closed circuit television and video surveillance
- Dispatch facilities
- Computer aided dispatching
- Database applications
- Geographic information systems
- In-vehicle video recording
- Intercom and public address systems
- Inventory management
- Message switching
- NCIC 2000 features and applications
- Records management systems
- Resource management systems
- Security alarms

- Response and support vehicles
- Wide area terrestrial voice and data networks
- Workstation furniture

The ten participating agencies' radio communications systems represent a combined expenditure of approximately $63,385,000 for FY 1997-1998. This represents over 96% of the State's annual expenditure on radio communications. The remaining 4% include agencies such as the Department of Motor Vehicles, Department of Mental Health, and the Department of Consumer Affairs. It is the goal of the ten participating agencies to develop systems to accommodate all of California's radio system users. The current costs for the ten agencies, as a percentage of total budget, are depicted (by agency) below and detailed in Exhibit I-2. This current budget is further described in the Alternatives Analysis section of this report. This CBA addresses only those items listed on the previous page as Radio System Components.

Agency Percentages of FY 1997-1998 Radio Budget [1]



Many of the State agencies have existing plans for improving radio and ancillary systems to meet current and outstanding needs. These efforts are both critical and unique to the mission of each agency. The Steering Committee recognizes that forging a new radio systems investment paradigm will take time and that the agencies' current initiatives should not be stopped, but should be coordinated with the State's overall plans. Thus the Strategic Plan must be updated on an on-going basis to reflect the activities of the individual agencies. The following are examples of existing initiatives that are coincident with this CBA:

[1] Budgets include current year initiatives

California Highway Patrol

- Feasibility Study Report for Computer Aided Dispatch (CAD)
- Frequency coverage modeling studies
- Traffic load study aimed at establishing statewide voice traffic distribution data
- RF channel plan development

California Youth Authority

- BCP in the amount of $839,000 was approved for the 1997/1998 Fiscal Year to develop and install an 800 MHz Trunked Radio System for the Heman G. Stark Youth Correctional Facility in Chino.
- BCP was developed for the 1998/1999 Fiscal Year to fund the installation of an 800 MHz Trunked Radio System for the Southern Youth Correctional Reception Center and Clinic in Norwalk. The current cost estimate is $726,000.

Department of Parks and Recreation

- Approved BCP to establish consolidated dispatch centers
- Feasibility Study Report for CAD enhancements

In summary, it is important to note that this State of California public safety radio communications project is unique in its scope and conception. Never before has any state project attempted to coordinate the work of so many public safety radio users.

C. PROBLEM/OPPORTUNITY STATEMENT

California's State public safety agencies are in critical need of improved field communications capability. This is crucial for the safety of the State's citizens and visitors, as well as for those sworn to protect them. These agencies require communications systems capable of supporting a wide variety of public safety and public service activities, as well as equipment with the functionality to provide field personnel with reliable and efficient communications capabilities, especially interoperability.

Several recent incidents, still vivid memories in the minds of many citizens, stand in testimony to the above statement. Examples of these incidents are provided as a reminder of

how the current ineffective radio communications systems can hinder public safety response and, in turn, reduce levels of service to the public:

Yuba County Floods

In Yuba County, Sheriff's Department personnel, local Search and Rescue (SAR) and Urban Search And Rescue (USAR) teams, State Fish and Game, local fire and CDF all required mutual aid communications during the recent floods in 1997. Management and coordination of these resources during the flood response were difficult and cumbersome because of the different radio frequencies in use.

Coordinating these search operations required three separate radios. Some of the teams went into the flooded areas on assignment without communications with the Command Post. These units then returned to the Command Post to relay information and receive new assignments. One example of the confusion this lack of direct inter-communication caused was demonstrated in Marysville where search teams from different disciplines were discovered to have searched the same submerged houses because they were not aware that another team had already performed that task. This delayed the response to other citizens in need and put State personnel into unnecessarily hazardous situations.

Chain Reaction Traffic Collisions

On November 29, 1991 CHP assumed full command of a multi-vehicle fatality accident that occurred near Fresno on Interstate 5. Very high winds blowing loose dirt from the adjacent fields created a low visibility situation on the roadway, which resulted in an enormous accident scene. This accident scene consisted of 33 collisions including a total of 164 vehicles and 349 people; the final accounting was 151 persons injured and 17 persons killed. Eventually, over 20 agencies participated in clearing this incident, including the California Department of Transportation, the California Department of Forestry, several emergency medical services, both public and private, and all local law enforcement. All of these agencies communicate on different bands and frequencies from the California Highway Patrol. As the lead agency it was incumbent upon the CHP officers on the scene to coordinate, prioritize, and occasionally direct the activities of the other agencies. The lack of a single frequency pair, a common radio band, or the capability to cross-band radio traffic among the participants severely hampered their ability to communicate quickly and clearly, resulting in delays in responding to the accident victims.

Multi-Year Flooding

During 1986, 1996 and 1997 California experienced major flooding, complicated by numerous and massive breaks in river levees. At these times, CHP officers were required to re-route traffic and coordinate the travel routes of various emergency responders as they attempted to assist local residents. Construction crews, repairing weakened levees and evacuating citizens, created unsafe situations on local roadways

that still required protection and on which traffic still needed to move efficiently. CHP officers on the scene were responsible for coordinating the emergency activities that included many various agencies, almost none that communicated on the CHP radio channels.

The only method available to CHP officers to communicate with the majority of agencies who operate on VHF High Band and on UHF band frequencies is through use of a scanner. The introduction, and rapid proliferation of trunking systems, however, renders the use of scanners for cross-communication ineffective.

Earthquake

In October 1989, during the World Series, a major earthquake occurred. The phenomenal damage to freeways and bridges was well documented on television and in newspapers worldwide. The collapse of the 880 freeway at Cypress was seen by millions of viewers, as was the ensuing rescue of many people trapped in vehicles between layers of roadway. In 1994, the Northridge earthquake shook down several major freeways, again exposing a California disaster to the observers of the world media. Although recoveries from major disasters are managed and coordinated under the responsibility of the local sheriff, the California Highway Patrol always responds when roadways and traffic are involved. Earthquakes present an ever-present challenge to public safety providers. CHP, for example, provides essential services critical to disaster recovery and lifesaving efforts, and in the process must coordinate with all available emergency response agencies and companies, public and private, local, State and federal. With very few exceptions, responding agencies are not on the same radio band (i.e., VHF Low Band) with the CHP. As a result, communications become very difficult in these disaster situations.

Civil Unrest

In the spring of 1992 the acquittal of the officers involved in the Rodney King incident in Los Angeles provided the impetus for one of the most serious, destructive, and dangerous civil disturbances of recent memory. It constituted the extreme example of another type of occurrence that required the essential services and coordination of many agencies. Civil disturbances also provide the greatest challenges for public safety agencies because they are so unpredictable. Effective response by law enforcement officers can reduce the destructiveness and scope of a civil disturbance because the circumstances tend to be fluid. This stands in contrast to response to natural disasters, where responders are reacting to somewhat static circumstances. In the case of civil disturbances, close coordination of all respondents must be achieved immediately and with absolute accuracy. The lack of interoperability in such cases results in the endangerment of citizens and public safety personnel, as well as loss of property.

Statewide Law Enforcement

CHP is the primary responder to all activities that require traffic control on freeways, expressways, State routes and, in unincorporated areas, on local streets and roadways.

CHP provides all dignitary protection services for the Governor of California, his family, and other executive officers, as well as all visiting dignitaries from other states and other countries. At the direction of the Governor, CHP provides local law enforcement assistance and support in several California communities. CHP is also a participant in numerous task forces formed to address specific criminal activities, including vehicle theft and drug transport and sale. The list of such scheduled activities is long and varied, but in every instance CHP is required to coordinate radio communications with agencies operating on different bands. In almost no case is an agency involved with CHP activity operating in VHF Low Band.

Although the CHP is central to the above examples as the primary law enforcement agency in the State, other agencies share many of the same difficulties while performing their own unique missions.

Problem Statements

"…the lack of effective and reliable radio communications impedes California's State public safety agencies' ability to perform their basic mission: the protection of life and property."[1]

As the obsolescence of radio communications systems across the State continues for the majority of agencies, the safety of field personnel and their ability to provide timely service to the public during emergency and routine operations is increasingly jeopardized.

Radio channels have become overcrowded and systems have become compromised by age, resulting in the loss of communications between public safety personnel with dispatchers and other field support. Response times have lengthened and incidents requiring multi-agency responses have become inefficient if not dangerous to citizens and public safety personnel. Impediments to effective communications have been identified in several key areas that include functionality, coverage, capacity, and interoperability. In the following sections, these problems and opportunities are numbered to correspond to the subsequent objective statements and functional requirements.

1.0 Less than fully functional systems compromise public safety – The typical life expectancy for most fixed radio systems can range anywhere from 6 to 15 years, depending on whether repair components continue to be available. Much of the State's existing radio system was installed over 10 years ago. Over 50% of the State's 53,000

[1] This statement was the foundation for Partnering for the Future: *A Strategic Plan for California's Public Safety Radio Communications System*, January 1997, prepared by the State's Public Safety Radio Strategic Planning Committee.

fixed, mobile, and portable radios are at or nearing the end of their useful life. In addition, the majority of the State's existing voice radio systems rely upon technology that is 30 years old. In one extreme example, the CHP is currently using radios and other communications equipment that are no longer sold or supported by the manufacturer. When the current CHP equipment inventories are depleted, there are no replacements.

The current radio systems are not capable of many features that will increase the safety of citizens and field personnel. For example, criminals use readily available technology to monitor public safety radio communications and thwart efforts or to interfere with emergency responses to citizens. In other situations, if an officer is not able to intelligibly speak into a radio, the current systems do not allow for that officer to depress a key, transmit an emergency distress signal, and have a dispatcher immediately identify which user sent the signal. Many other features have been developed to address these and other safety issues.

2.0 Inadequate radio coverage compromises public safety – Comprehensive radio coverage does not exist throughout many areas of the State, particularly in remote and rural areas. For example, in many areas of northern California, field personnel are unable to contact dispatchers to obtain assistance. Likewise, dispatchers often are not able to contact field personnel to quickly respond to citizen needs. Even along established highways, there are "dead spots" where communications to and from field personnel are not possible. Radio transmission limitations, terrain features, and the high cost of establishing fixed radio sites make it problematic to provide universal coverage throughout the State. As a result, public and personnel safety are compromised.

3.0 Channel congestion compromises public safety – Because radio channel access is limited, especially in urban areas, many State agencies currently operate near, and often exceed, the capacity of their existing communications systems. Field users experience significant delays while attempting to transmit both routine and emergency messages. Until the current user releases a radio channel, no other users can access that channel. The Department of Justice currently avoids simultaneous surveillance operations in some areas of southern California due to the lack of available channels to support more than one task force. Field and dispatch personnel often require immediate access to radio channels, and delays while waiting for "free air time" compromise citizen and officer safety during emergency situations where even seconds are precious.

As the State's population continues to increase, so does the need for public safety services. A corresponding increase in the number of calls for service received by public safety providers is expected to mirror that growth in population. Since the current systems are operating at capacity, it is likely that these systems will be unable to accommodate even routine use, let alone to meet citizen and officer emergency requirements.

4.0 Lack of interoperability compromises public safety – The State's public safety agencies currently operate systems in every available frequency band allocated for

public safety use. These bands include Very High Frequency (VHF) Low Band, VHF High Band, Ultra High Frequency (UHF), and 800 MHz. The increasing complexity, size, and frequency of disasters and emergency incidents escalate the requirements for coordinated, multi-agency response among the different levels of government in order to respond to citizen needs.

Public safety responders require communications with federal and local public safety agencies, but are unable to contact them without having multiple radios (users operating in one frequency band cannot talk to users operating in a different band). Since effective interagency communications is an essential component of any coordinated response, separate and incompatible radio systems create a technological environment in which it is difficult, and at times impossible, for agencies to communicate with each other to meet citizen needs.

Opportunity Statements

In addition to the problems, there also are opportunities for improving the State of California's public safety radio communications. These opportunities include the availability of new spectrum, improvements to overall cost effectiveness, and mobile data communications capabilities. By seizing these opportunities, California can enhance its ability to improve safety and response to citizen needs.

5.0 New spectrum will enhance public safety – Today, in many areas of the country, the demand for radio spectrum resources exceeds the availability of those resources. Even so, the demand for additional spectrum is expected to double in the next 10 years as the population increases and the demand for commercial services such as personal communications, paging, and mobile data also rises. To meet some of the public safety demands, the FCC is allocating 24 MHz of new spectrum in the 746 – 806 MHz band for public safety use. Comprehensive planning, coordination and fiscal support are required to receive channel allocations since the Commission will not allocate spectrum without these commitments. By acting decisively, the State of California can take advantage of this rare window of opportunity to make needed improvements in public safety radio communications. As in the past, however, if California does not react swiftly, the competition for spectrum resources will close this window of opportunity and severely impact the State's ability to respond to public needs. The State could very well be shut out of this opportunity and find itself waiting for years for necessary spectrum, further compounding current problems.

6.0 Cost effective systems can enhance public safety – Shared systems reduce capital and recurring costs because agencies can share expensive site development and equipment. The State's public safety agencies have an opportunity to share the development of systems and equipment as well as radio towers and equipment vaults. Standardized equipment also lowers recurring costs due to reduced parts inventories and standardized repair and maintenance practices. Cost efficiencies also are achieved

with combined systems that require less equipment to meet the needs of the same number of users.

7.0 Mobile data technology will enhance public safety – Advances in data and video communications technologies provide a wealth of new capabilities and applications that can aid public safety personnel in the performance of their duties. It is anticipated that the majority of public safety radio transmissions will be digital in the future. Mobile data technology can enhance public safety through immediate field access to information such as hazardous materials, premise warnings, digital images, and other critical information. Law enforcement agencies in the State need the ability to query the database information provided by the various levels of government from the local agencies to the federal level. Federal programs such as the National Crime Information Center (NCIC) 2000 project, which will make field identification of individuals more reliable, will soon be available.

D. OBJECTIVES

California's State public safety agencies have formed a common vision in which modern mobile communications technology will continue to enhance the delivery of public safety services well into the 21st century. The primary objective of any system improvements is to provide improved and responsive service to citizens of, and visitors to, California.

In order to improve citizen and personnel safety, the State's public safety agencies have identified specific objectives associated with the problems and opportunities facing the State. The following is an overview of these objectives. Where possible, quantitative performance measures of these objectives have been identified.

Problem: 1.0 Less than fully functional systems compromise public safety

Objectives:

1.1 Decrease risk for field personnel by implementing modern radio features – By implementing modern radio features (e.g. emergency alerting, unit identification, unit disable, etc.), field personnel will be better protected and will be better able to serve the public needs.

1.2 Increase radio message security measures (i.e. lessen the probability of message interception or interference) – By migrating to digital operations and using mobile data when appropriate, message transmission can be kept more secure, thereby providing another layer of safety for field personnel, resulting in enhanced protection for the public. Radio transmissions will be more clear and will require less repetition, resulting in improved responsiveness to the public.

Problem: 2.0 Inadequate radio coverage compromises public safety

Objectives:

2.1 Support universal, statewide access, and unit-to-unit communications capability – Public safety radio users require access to dispatch services to request backup, report events in progress, provide warnings to other responders and respond to citizen needs. Dispatch services are critical to coordinating field resources, providing access to criminal justice and other information, and linking field personnel with dispatch assistance during emergencies or disaster situations. In order to satisfy basic needs, communications systems should be designed to enable field personnel to have access to dedicated, State-operated dispatch centers at any time of the day or night. Also, coverage should be comprehensive so that both low-power portable units and vehicle mounted mobile units have system access and can communicate directly with each other and dispatch.

2.2 Provide a minimum 95% portable radio coverage in urban areas – Basic communications capabilities must be available to every public safety service provider in order to properly respond to citizen needs. Since users are frequently out of their vehicles when operating in urban areas, portable radio coverage is required to support public safety operations that extend through "urban canyons" and in concrete buildings. Portable coverage should be comprehensive so that the user is successful, in urban areas, on at least 95% of the first attempts to gain system access. Access should be provided with a Delivered Audio Quality (DAQ) of at least 3.0 which is defined as the ability to effectively communicate with only occasional need for repetition. This DAQ is further defined in the Telecommunications Industry Association (TIA) TR8 Working Group 8.8 document.

2.3 Provide a minimum 95% mobile radio coverage in rural areas – The terrain patrolled by public safety personnel includes freeways, forests, beaches, mountains, and deserts. Many public safety personnel frequently patrol the most remote of these areas alone. Basic communications capabilities must be available to every public safety service provider as he or she travels throughout the State to meet personal safety needs as well as to ensure dispatch access to field personnel for response to citizen calls for service. The radio system should provide the required access so that communications from any point within the State's boundaries is attainable on at least 95% of the attempts made to transmit on the system with a delivered audio quality of at least 3.0.

Problem: 3.0 Channel congestion compromises public safety

Objectives:

3.1 Make efficient use of existing radio channel resources – More efficient use of spectrum can be achieved through a migration to spectrum-efficient technologies. Narrower channels, digital transmission, and trunking approaches have the potential to dramatically increase the number of users a single channel can support, and thus increase overall system capacity. Also, system sharing provides an opportunity to

reduce the amount of duplicate radio systems and make better use of limited radio frequencies. User access to channels when needed will enhance citizen and personnel safety.

3.2 Support a P.01 grade of service for channel access (i.e., 1% or less of the calls attempted will be blocked or delayed) – Reliability of radio systems implies several characteristics. First is the assurance that there is redundancy built into the system so that in the event some portion of the system fails, there are backups to accommodate demands on a temporary basis. Next is the confidence that users have in operating systems that experience few occurrences of equipment failure. Lastly is the ability of users to gain channel access when required. This reliability factor is a function of channel congestion and system loading. Reliable communications systems that are engineered and maintained to support the necessary number of users and to withstand natural disasters and other emergencies are a priority for the State. A highly reliable system would provide system access on 99% (or better) of the first attempts made to transmit on the system, resulting in better response to citizen needs.

3.3 Acquire additional channel resources to provide for growth - Public safety system users require flexibility and rapid system reconfiguration to accommodate peak use. During disaster situations many new users may come on the system simultaneously, impacting the ability to respond to public needs. This is especially true of emergency management and disaster services, which are characterized by very low levels of voice traffic during routine operations, but extremely high levels during a major event such as an earthquake, flood, or wildland fire.

Problem: 4.0 Lack of interoperability compromises public safety

Objectives:

4.1 Provide users with direct interoperability with state, local and federal public safety agencies - The ability to communicate between public safety agencies is fundamental to the effective protection of life, health, and property. A radio communications system solution should provide "seamless" interoperability to enhance citizen safety. Proprietary, incompatible technologies should not impede interoperability.

4.2 Support simplified seamless statewide system access – By implementing systems that can support user equipment from many agencies, the problems associated with multiple, incompatible systems are lessened. Users from any agency gain system access while operating anywhere in the State, not just in the primary operating area associated with that agency's jurisdiction. This enhances the ability to roam throughout a wide area when necessary and provides the capability to move resources quickly to respond to disasters.

4.3 Acquire systems designed with "open" architectures (i.e., achieve statewide system standardization) – By implementing systems designed with proprietary technologies, the State could find itself in a position where future procurements related to those systems would be of a sole source nature. In order to avoid this eventuality, efforts will

need to be made to implement technologies that are open, support "backward compatibility," and/or are standard to multiple manufacturers. This will allow future flexibility in terms of choices for technology migration and will increase the degree to which agencies will have the ability for direct interoperability (i.e., without the benefit of additional technology specifically designed to patch differing systems together).

Opportunity: 5.0 New spectrum will enhance public safety

Objectives:

5.1 Form partnerships and system-sharing arrangements that provide for efficient and effective use of radio communication resources – Public safety systems that provide capabilities to meet multiple agency requirements can cost effectively be shared between agencies. System users will realize lower costs through reduction in the number of sites and through the consolidation of support resources. By reducing the total amount of required spectrum, they may be in a better position to acquire the necessary resources from the FCC. Communications systems developed in partnership between agencies will ensure that agency needs are met and cost efficiencies are achieved.

5.2 Acquire necessary spectrum resources to meet the State's outstanding radio communications needs - Due to propagation characteristics, equipment availability, and the need for interoperability, spectrum from 150 MHz to 870 MHz is currently considered the ideal range for public safety communications. Obtaining additional spectrum in the current era of scarcity and increased competition will not be an easy task. Agencies that can demonstrate a definitive plan for the use of new frequencies, funding availability, and a commitment to shared use will likely be considered a higher priority for new spectrum allocations. The acquisition of spectrum to meet current and future needs is one of the highest priorities that the State faces. The State's existing communications systems currently support over 43,000 public safety radio users. Over the next 10 years, this number is expected to steadily increase to over 51,000 users. In particular, there is the potential for the Department of Corrections' projected 31% growth in the inmate population to drive a proportionate increase in the current number of radios.

Opportunity: 6.0 Cost effective systems will enhance public safety

Objectives:

6.1 Form system-sharing partnerships to improve cost effectiveness - Increasing costs of technology and the growing need for government to do more with less has made acquiring the necessary funding for capital improvements exceptionally difficult. No State agency has the ability to pursue acquisition of the selected communications solutions unless they are affordable. Communications systems must be cost efficient with respect to both one-time procurement costs and recurring costs. Replacement parts and components must be available throughout the system's expected lifetime. Communications systems must accommodate sufficient units and user agencies to

allow effective use and cost sharing. Systems developed in partnership between agencies will ensure that each agency's needs are met and cost efficiencies are achieved.

6.2 Standardize equipment to minimize inventory, maintenance and administrative costs - By implementing standard equipment, the procurement process can be streamlined, and the cost of maintaining multiple types of systems will decrease. Cost efficiencies will be due in large part to economies of scale associated with procuring large numbers of standard replacement equipment as opposed to smaller numbers of specialty equipment.

6.3 Improve the acquisition and use of system administration and management information - By improving the ability of system administrators to analyze system usage, greater operating efficiencies can be gained. When system use and traffic information is collected in a meaningful way, it yields a picture of how field resources are deployed, and in turn, how to better use those resources for responding to citizen needs.

Opportunity: 7.0 Mobile data technology will enhance public safety

Objectives:

7.1 Acquire mobile data capability to provide enhanced access to information in the field - While voice communications remain the primary form of information transfer among public safety agencies today, by the year 2010, data and image transmissions may account for a majority of all public safety communications. In the future, mobile data will be required to support such federal initiatives as the Integrated Automatic Fingerprint Identification System (IAFIS) and the National Crime Information Center (NCIC) 2000 project.

7.2 Improve safety, security and privacy to the public and public safety response personnel by providing warning information - Premise warnings and hazardous materials information provide public safety providers with information that greatly improves the effectiveness of their responses, and in turn, improves the service levels offered to the public. Public safety personnel who are informed ahead of time as to what to expect upon responding to an incident, will more quickly, efficiently, and with less chance of injury, respond to the public.

7.3 Reduce channel congestion by transmitting information in its original, digitized form - Current channel loading is such that most public safety radio channels are loaded to maximum capacity, and in many cases are exceeding capacity. One possible means of alleviating this problem is to reduce voice traffic and use mobile data for routine items such as ID checks, requests for wants & warrants, license plate checks, etc. Such information can be accessed easily from several available databases and does not require a dispatcher to intervene on the communication.

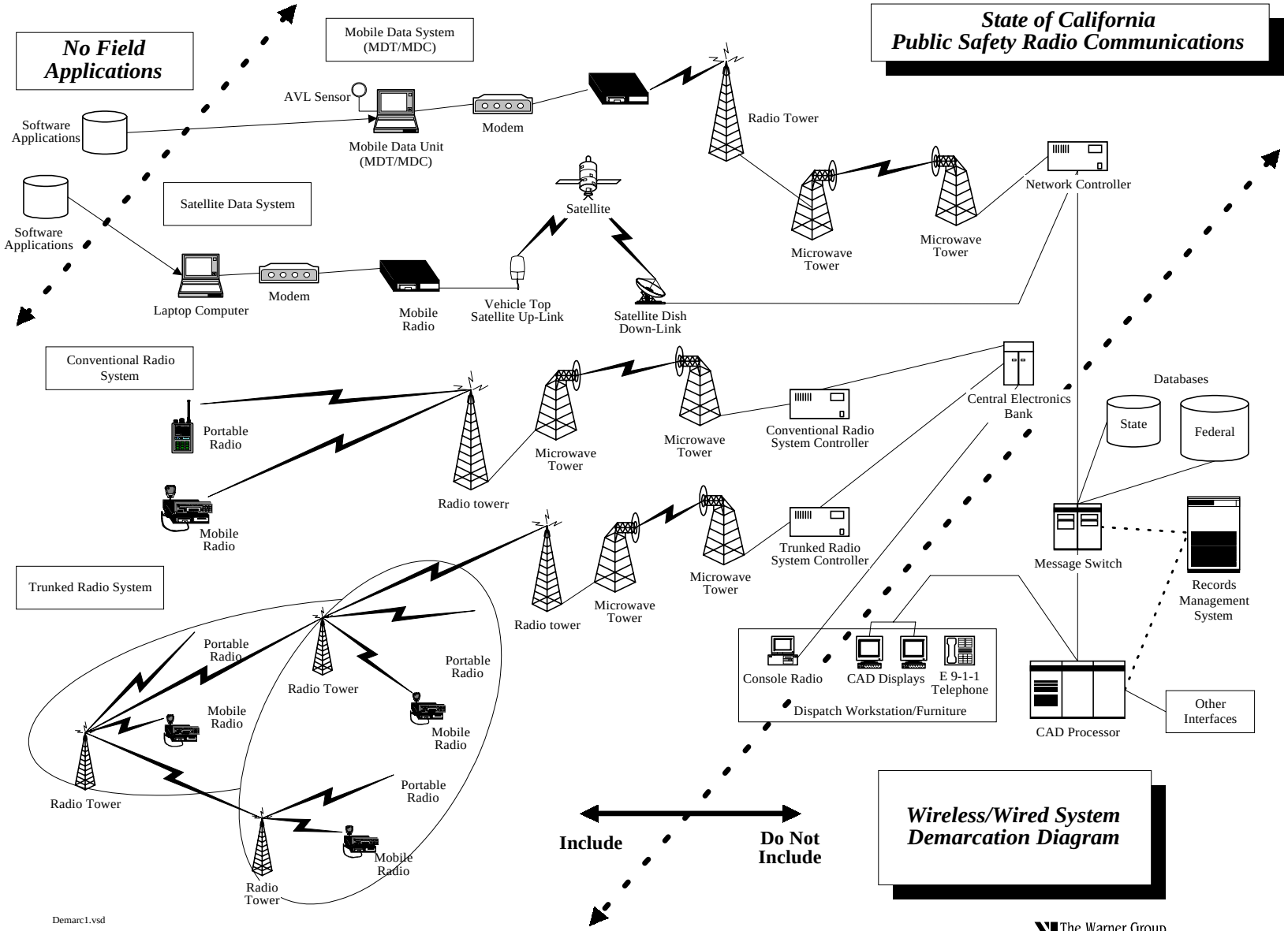
7.4 Provide rapid access to critical information - On many occasions, public safety providers must act quickly and lives or property may be jeopardized if the responder must wait for critical information. Mobile data can provide these personnel with rapid access to this critical information without the cumbersome delays sometimes associated with waiting for voice contact or information request confirmation.

Each of these objectives is supported by specific functional requirements that identify system capabilities necessary to meet these objectives. A master list of the problems, opportunities, objectives and requirements is provided in Exhibit I-3. The system requirements are provided in detail in Exhibit I-4.

REQUIREMENTS

EXHIBITS

THE WARNER GROUP


State of California
Public Safety Radio Communications
No Field Applications
Mobile Data System (MDT/MDC)
AVL Sensor
Software Applications
Mobile Data Unit (MDT/MDC)
Modem
Radio Tower
Satellite Data System
Satellite
Software Applications
Laptop Computer
Modem
Mobile Radio
Vehicle Top Satellite Up-Link
Satellite Dish Down-Link
Microwave Tower
Microwave Tower
Network Controller
Conventional Radio System
Portable Radio
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Conventional Radio System Controller
Central Electronics Bank
Databases
State
Federal
Trunked Radio System
Portable Radio
Portable Radio
Radio Tower
Mobile Radio
Mobile Radio
Radio Tower
Portable Radio
Mobile Radio
Radio Tower
Radio tower
Microwave Tower
Microwave Tower
Trunked Radio System Controller
Message Switch
Records Management System
Console Radio
CAD Displays
E 9-1-1 Telephone
Dispatch Workstation/Furniture
CAD Processor
Other Interfaces
Include
Do Not Include
Wireless/Wired System Demarcation Diagram
Demarc1.vsd
The Warner Group

Exhibit I-2

State Agency Radio Budgets *

Agency Radio Budgets, FY 1997-1998	
Agency	***Budget***
California Highway Patrol	$27,067,000
Department of Corrections	$5,050,000
Department of Fish and Game	$1,555,000
California Department of Forestry and Fire Protection	$10,700,000
Department Of Justice	$534,000
Department of Parks and Recreation	$3,360,000
Department of Transportation	$10,413,000
Department of Water Resources	$2,014,000
Department of the Youth Authority	$1,020,000
Governor's Office of Emergency Services	$1,672,000
TOTAL	***$63,385,000***

* Includes current year Budget Change Proposals (BCPs).

STATE OF CALIFORNIA
Public Safety Radio Communications Project
Master List of Problems/Opportunities, Objectives, and Requirements

Problems/Opportunities		Objectives		Requirements (voice and data)	
1.0	Personnel safety adversely affected by less than fully functional systems	***1.1***	Decrease risk for field personnel by implementing modern radio features	***1.1.1***	Call/unit prioritization
				1.1.2	Emergency alerting
				1.1.3	CAD unit display
				1.1.4	Out of range indication
				1.1.5	Talk around (direct unit to unit)
				1.1.6	Individually addressable units
				1.1.7	Private unit-to-unit conversations
				1.1.8	Multi group call
				1.1.9	Unit identification
				1.1.10	Telephone interconnect
				1.1.11	Dispatch (point to multi-point)
		1.2	Increase radio message security measures (lessen probability of message interception or interference)	***1.2.1***	Encryption
				1.2.2	Unit disable
2.0	Poor radio coverage	***2.1***	Universal, statewide access to dispatch support and unit-to-unit communications capability to include interior of designated State buildings	***2.1.1***	Roaming
				2.1.2	Critical buildings
		2.2	Provide 95% portable radio coverage in urban/metro areas	***2.2.1***	Portable coverage
		2.3	Provide 95% mobile coverage in rural areas	***2.3.1***	Mobile coverage
3.0	Existing radio channels are congested	***3.1***	Make more efficient use of existing channels	***3.1.1***	Narrowbanding
				3.1.2	Flexible channelization
				3.1.3	Dynamic regrouping
		3.2	Support a P.01 grade of service for channel access	***3.2.1***	Immediate channel access
				3.2.2	Grade of service
		3.3	Acquire additional channels	***3.3.1***	System growth
4.0	Interoperability is lacking at all levels of government	***4.1***	Provide users with direct interoperability to local and and federal agencies	***4.1.1***	Multi-agency (state)
				4.1.2	Multi-agency (local)
				4.1.3	Multi-agency (federal)
		4.2	Support seamless statewide system access	***4.2.1***	Reduce complexity
		4.3	Acquire systems designed with "open" architectures to gain statewide systems standardization	***4.3.1***	Reduce spare parts inventory
5.0	Availability of new spectrum	***5.1***	Form partnerships and system sharing arrangements which provide for efficient use of spectrum resources	***5.1.1***	Multi-agency systems
		5.2	Acquire necessary spectrum resources to meet the State's radio communications needs	***5.2.1***	Expansion
6.0	Improve system cost effectiveness	***6.1***	Form system sharing partner-ships to reduce required fixed infrastructure costs	***6.1.1***	Shared systems
		6.2	Standardize equipment	***6.2.1***	Standard equipment
		6.3	Improve system administration and management information	***6.3.1***	Management reporting
7.0	Mobile data technology	***7.1***	Acquire mobile data capability	***7.1.1***	Computer aided dispatch (CAD)
				7.1.2	Database information (CLETS, DMV, etc.)
				7.1.3	Specialized database information
				7.1.4	Records management system (RMS)
				7.2.1	Automatic vehicle location (AVL)
		7.2	Increase personnel safety	***7.2.2***	Premise warnings
				7.2.3	Hazardous materials information
				7.2.4	Images
		7.3	Reduce channel congestion	***7.3.1***	Electronic messaging
		7.4	Provide rapid access to information	***7.4.1***	Response time
				7.4.2	CAD response

SYSTEM REQUIREMENTS

The following functional requirements provide additional detail of the features and capabilities necessary to meet the State's public safety communications objectives. The scope of these capabilities allows the State to meet current and future needs and to realize radio communications systems opportunities. The requirements are numbered to provide a direct association with the previously described problems, opportunities, and objectives.

1.1.1 Call/unit prioritization – Ability to prioritize call and unit access to the dispatch network. When a radio channel is available, the next unit to transmit proceeds unimpeded. When radio calls are queued, the controller can be programmed to prioritize certain messages to provide them the next access to a channel.

1.1.2 Emergency alerting – Ability to activate a "one-button" emergency alerting feature from mobile or portable units. Each radio is provided with a specific emergency alert button. When depressed, the system provides the highest priority access to a radio channel.

1.1.3 CAD unit display – Ability for a dispatcher to retrieve and display unit identification (ID) information through a Computer Aided Dispatch (CAD) system. As each radio transmits, their numeric or alphanumeric identifier is displayed on the CAD status display. This identifier may also be appended to incident records to provide a unit or incident chronology.

1.1.4 Out of range indication – Ability for a radio unit to indicate to the user when it is out of range of the primary system. Using conventional technology, a radio user must make a radio call and listen to see if anyone heard the transmission. With trunking systems, each radio is constantly listening to a control channel that provides an indicator of the ability to access the fixed radio site.

1.1.5 Talk around (direct unit-to-unit) – Ability to communicate in a "talk-around" mode whereby the radio system is bypassed and messages are not transmitted through fixed system repeaters. Under some circumstances, a portable radio is used in canyon areas or basements where the signal cannot reach a fixed base station or repeater. In these situations, the unit should be able to communicate with other portables in the near vicinity.

1.1.6 Individually addressable units – Ability to signal (call) an individual unit. This feature provides the ability for a dispatcher supervisor to call a single, specific unit without addressing the call to an entire fleet of units.

1.1.7 ***Private unit-to-unit conversations*** – Ability to engage in private (i.e., unit-to-unit) conversations. This provides the ability to have a restricted conversation between units without disturbing the remaining units in an organization.

1.1.8 ***Multi-group call*** – Ability to signal or call one or more specific groups of users. This feature provides the ability to direct an alert message to numerous units simultaneously.

1.1.9 ***Unit identification*** – Ability to receive and display the unit identifier of the transmitting unit. This provides the ability to see the alphanumeric designator of the calling unit.

1.1.10 ***Telephone interconnect*** – Ability to connect to the public switched telephone network. This provides the ability to dial a telephone call from a mobile or portable unit, thus allowing communications with others not having a radio.

1.1.11 ***Dispatching (point to multi-point)*** – Ability to transmit from a single unit to many units or "talk groups" with the touch of a single button. This provides the ability to transmit a dispatch message to multiple units simultaneously.

1.2.1 ***Encryption*** – Ability to transmit encrypted voice messages. Encryption provides the ability to transmit confidential or tactical messages between users. Encryption provides an enhanced level of security even when a compatible radio or receiver is monitoring the communications.

1.2.2 ***Unit-disable*** – Ability to remotely disable a lost or stolen radio unit. If a unit is stolen, it may be used to disrupt public safety communications. This feature allows the radio to be remotely deactivated.

2.1.1 ***Roaming*** – Ability to roam anywhere within the State, to include inside designated buildings, and gain access to dispatch support and other radio system users. Roaming allows units to use the radio network without having to refer to coverage maps or channel plans to determine the appropriate frequency to use.

2.1.2 ***Critical buildings –*** Ability to access dispatch services from within State owned and operated facilities. These critical buildings include: (to be provided). Facility and dignitary protection responsibilities require radio communications capability within facilities.

2.2.1 ***Portable coverage –*** Ability to provide 95% portable radio coverage in urban and metropolitan areas of the State with a delivered audio quality of DAQ 3.0. This is required since in urban areas, there is a higher likelihood that individuals will be away from a vehicle or in a building.

2.3.1 ***Mobile coverage –*** Ability to provide 95% mobile radio coverage in rural areas of the State with a delivered audio quality of at least DAQ 3.0. In rural areas, most users will be associated with vehicular transportation.

3.1.1 ***"Narrowbanding" –*** Ability to provide a minimum of 2 to 1 improvement in channel capacity and utilization. In response to potential mandates for spectrum efficiency, and requirements for newly manufactured equipment, new and replacement systems should support improved spectrum efficiency.

3.1.2 ***Flexible channelization*** – Ability to provide flexibility in assigning channel designations and unit groupings. The ability to redefine channel designations and group associations provides flexibility in meeting changing agency requirements.

3.1.3 ***Dynamic regrouping*** – Ability to dynamically regroup users based on need or priority. This feature allows for the quick reconfiguration of channels and talk groups based on emergency or disaster conditions or during periods of high loads.

3.2.1 ***Immediate channel access*** – Ability for users to gain emergency communications channel access. Under emergency conditions, an individual may have limited ability to make repeated calls for assistance. This feature provides for single attempt assess to the radio channel.

3.2.2 ***Grade of service –*** Ability to provide a P.01, or better, grade of channel access service. A P.01 grade of service provides that only one attempt at channel access in one hundred accesses is blocked or busied.

3.3.1 ***System growth –*** Ability to expand channels to accommodate growth in users and message volumes. The feature allows for the system to add channels and capacity without the need for extensive replacement of system controllers.

4.1.1 ***Multi-agency (State)*** – Ability for agency personnel to communicate with multiple State agencies. This allows for the State's public safety agencies to intercommunicate.

4.1.2 ***Multi-agency (local)*** – Ability of agency personnel to communicate with multiple local public safety agencies. This allows for the State agencies to interoperate with local public safety agencies.

4.1.3 ***Multi-agency (federal)*** – Ability for agency personnel to communicate with multiple federal public safety agencies. This allows for the State agencies to communicate with federal agencies.

4.2.1 ***Reduce complexity –*** Ability to support simplified access to radio system features. Radio users should not be required to consult extensive documentation to utilize radio

system features or to determine which radio site is available and which dispatch center it is connected to.

4.3.1 ***Reduce spare parts inventories –*** Ability to provide for modular replacement of radio units and interchangeability among systems. Modular components provide for the quick repair and replacement of components. Economies of scale for purchases and parts inventories can also be realized.

5.1.1 ***Multi-agency systems –*** Ability to support multiple user agencies at all levels of government. This feature allows for the cooperative use and administration of the radio communications system.

5.2.1 ***Expansion*** – Ability to provide new spectrum resources to meet State agency needs through the year 2012. Due to the long term nature of the system investment and the long duration logistics of radio systems, the ability to expand channels ensures that the State's needs will be met in the long term.

6.1.1 ***Shared systems*** – Ability to provide modular replacement and upgrade of system hardware and software. Compatibility between agencies will distribute the costs of system upgrades.

6.2.1 ***Standard equipment*** – Ability to provide standardized mobile, portable, and fixed radio equipment. Similarity of equipment and features will reduce complexity and overall user training requirements.

6.3.1 ***Management reporting –*** Ability to accumulate and analyze system utilization and traffic information. Management information will provide enhanced capabilities in the administration and maintenance of the system.

7.1.1 ***Computer Aided Dispatch*** – Ability to interface with Computer Aided Dispatch (CAD) systems. This interface will provide CAD dispatch and database information to be received by mobile units. The mobile units will also be able to respond to CAD dispatch and messaging.

7.1.2 ***Database information (CLETS, DMV, etc.)*** – Ability to access information from state and federal databases. This feature allows units to access database information independently without additional manual inquiries by dispatchers or support personnel.

7.1.3 ***Agency specific data needs –*** Ability to support agency-specific user information needs. Additional agency-specific information systems have been established, as well as the accumulation of important database information critical to field personnel. This interface would allow the remote access and update to these applications.

7.1.4 Records management system – Ability to interface with agency-specific records management systems (RMS). Many agencies have implemented incident-based reporting systems. This interface would allow the inquiry of information contained in these systems as well as the input of information from the field.

7.2.1 Automatic vehicle location – Ability to provide vehicle position reporting and support for automatic vehicle location (AVL) technology. This capability provides vehicle location information to a centralized point, such as a dispatch center. AVL provides enhanced unit dispatch capability as well as providing additional personnel safety information.

7.2.2 Premise warnings – Ability to provide premise information and warnings. These warnings allow improved preparation by emergency responders to incident locations.

7.2.3 Hazardous materials information – Ability to provide site-specific and hazardous materials information to responders. Hazardous material information is critical to the safe response and handling of incidents.

7.2.4 Images – Ability to transmit and receive image (e.g., mugshot, geographic, etc.) files. Field identification of suspects allows for improved service to the public by verifying individuals on location rather than transporting them to a booking facility and performing the identification.

7.3.1 Electronic messaging – Ability to support alphanumeric electronic messaging. This feature allows individuals to send electronic messages which provide better clarity, privacy and accountability than voice messages.

7.4.1 Response time – Ability to transmit responses to user inquiries within 30 seconds. Rapid responses to inquiries are necessary during volatile situations or when the duration of a field contact presents additional safety considerations (e.g., being stopped on a freeway).

7.4.2 CAD response – Ability to transmit dispatch information within 15 seconds of call entry and assignment. To fully use the ability to transmit dispatch information, the information should be delivered at least as fast as a voice dispatch. Depending on the nature of the call for service, seconds may be critical to saving a life.

Agency Unique Requirements

Unique agency requirements for systems, equipment functions and capabilities are included in Appendix A.

SECTION II

PROPOSED ALTERNATIVE

THE WARNER GROUP

A. INTRODUCTION

Agency System Sharing offers the best opportunity to address Department communications needs and to improve interoperability, both for day-to-day operations and emergency response situations. Further, shared systems are the most cost-effective means to obtain enhanced system functionality and the most effective way to pursue new spectrum allocations.

The proposed solution is drawn from the conclusions reached in the Analysis of Alternatives, Section III of this document, which reflect the following:

- ***The State cannot maintain the status quo*** – Technology changes, resulting in manufacturers no longer supporting equipment in certain portions of the spectrum, and federal mandates, such as narrow-band spacing requirements, will not allow continued use of current baseline technologies. The problems Departments currently experience, stemming from operating systems that do not support Public Safety-related agency needs, will continue to plague public safety operations.

- ***The State cannot afford continued development of independent systems*** – Although the development of independent systems by the State's public safety Departments would address most unmet needs, it would cost more than the implementation of shared systems. In addition, this independent approach does not enhance critically needed interoperability nor does it promote operational efficiencies.

The following is a summary of how implementation of Agency System Sharing addresses the problems and opportunities outlined in the Requirements Section of this document.

1.0 Problem: Less than fully functional systems compromise public safety

Shared systems increase the capability of public safety professionals to accomplish their missions

- Shared systems provide a cost-effective implementation of trunked and conventional systems for all agencies, thereby introducing operational, system administration and safety features not available to users of stand-alone conventional systems.

- By promoting cost efficiencies, shared systems facilitate use of digital systems, thereby introducing an added measure of transmission security and personnel safety.

2.0 Problem: Inadequate radio coverage compromises public safety

Shared systems offer the opportunity to build out systems with comprehensive coverage

- Shared systems enable multiple agencies to provide comprehensive radio coverage in areas that are too costly to develop independently.

3.0 Problem: Channel congestion compromises public safety

Shared systems provide channel congestion relief

- Shared systems reduce the number of radio channels required to support State agency needs.

- Shared systems promote the use of trunking, which provides for more effective use of channel resources.

- Operational separation, the separation between agencies with differing functional missions, is maintained on shared channels, via trunking technology.

- Implementing trunked systems permits prioritization of users and messages, which allows for emergency system access as required.

4.0 Problem: Lack of interoperability compromises public safety

Shared systems improve the ability to communicate directly with mutual aid cooperators

- Shared systems, using common frequency bands, provide direct interoperability among partner (or participating) agencies.

- Shared systems support the cost-effective use of gateway technology for communications between shared system users and non-participating agencies.

- Shared systems promote the use of standardized equipment and common channels which simplify mutual aid communications and coordination.

5.0 Opportunity: New spectrum will enhance public safety

Shared systems support continued system growth through the use of mobile data and the commitment to spectrum efficiency

- Shared systems prove the intent and commitment of State agencies to pursue efficient use of spectrum.

- Comprehensive, full-featured radio communications systems can support local agency requirements where local efforts are not affordable.

6.0 Opportunity: Cost-effective systems will enhance public safety

Shared systems improve cost effectiveness

- Shared systems reduce the overall requirement for fixed system equipment, thereby reducing initial capital investments.

- By standardizing fixed equipment, maintenance costs will decrease.

- Consolidating communications sites and equipment vaults will reduce the overall repair effort and travel requirements to access and service remote radio sites.

- Larger system procurements provide opportunities for reduced pricing.

7.0 Opportunity: Mobile data technology will enhance public safety

Shared systems provide faster, more accurate access to information and the ability to support continued system growth through the use of mobile data

- By leveraging sites developed for voice radio, shared data system use reduces new site requirements and costs.

- Shared data systems enable the rapid transmission of information without the requirement for human intervention and the potential for delay and errors.

- Shared data systems reduce voice channel congestion, thereby increasing operational efficiency and provide personnel safety when emergency access to voice channels is necessary.

B. CONCEPTUAL DESIGN

By moving forward with the proposed alternative, the participating Departments will implement shared, statewide, public safety radio communications systems. These systems will be designed with consideration given to the following elements:

- Hybrid voice and data networks (i.e., operation in multiple spectrum bands, utilizing modern switching technology)
- System optimization necessary to meet agency-unique requirements

- Use of various technologies (e.g., terrestrial systems, satellite systems, etc.)
- Leveraging existing facility and equipment investments to the maximum extent possible

Projected Statewide Coverage Requirements

The first step necessary to initiate a migration from independent systems to shared systems is to determine the areas of the State that are best covered by a particular frequency band. This critical information is required to properly leverage the backbone that is present in a specific region of the State, and to most efficiently design a robust, hybrid radio backbone. In regions where terrain limitations impede radio coverage, it is not cost effective to build out a backbone in the higher (e.g. 800 MHz) frequency bands, as the number of sites required becomes cost prohibitive. In these areas, it is more prudent to maintain infrastructure in the lower frequency bands, e.g., VHF High-Band, for the radio backbone. Since agencies have different coverage requirements, support varying numbers of users, and deal with different mutual aid cooperators, it becomes critical to understand where the demarcation lines will be between areas of 800 MHz coverage and areas of VHF High-Band only coverage.

A comprehensive propagation study, conducted by the Department of General Service's Telecommunications Division, showed that the State's primary service areas (approximately 80% of the State's total geographic area) could be covered at a rate of 95% reliability under the system configuration shown in Exhibit II-1. This hybrid system configuration shows the southernmost two-thirds of the State supported by both VHF High-Band coverage and 800 MHz coverage, and the northernmost one-third of the State supported by VHF High-Band only coverage. It should be noted that much of the southernmost two-thirds of the state, which covers the State's urban areas, is the region in which many 800 MHz systems have either already been installed or are in the planning stages.

Coverage predictions indicated that to blanket the State with only 800 MHz infrastructure it would require well over 2,500 radio sties; however, to provide the 80% area/95% reliability coverage indicated above, with a hybrid VHF High-Band/800 MHz backbone, it would only require 1,025 sites. Of these 1,025 sites, 377 are existing VHF High-Band sites, located throughout the State. These 377 sites would also be used as part of the 800 MHz backbone wherever available in the southern two-thirds of the State. The remaining 648 sites necessary

to complete the 800 MHz coverage will either be developed or acquired prior to initial hardware installation. Thus, VHF High-Band coverage would be provided throughout the entire state, but 800 MHz coverage would only be available in the southern two-thirds of the State.

Systems Overview

The following descriptions summarize the configuration of the proposed hybrid system.

- ***746-869 MHz Band Voice Radio*** – A complete system replacement is required for CHP. At this time, the 746-869 MHz spectrum affords the best opportunity to license many of the required number of channels, for this agency and others. The FCC is refining its requirements regarding the use of this spectrum, and the recommendation for its use by the State is somewhat dependent on the outcome of these requirements. Although the 746-869 MHz band (which includes previous 800 MHz allocations) appears to be the best candidate for use by public safety agencies in the State, it should be noted that user needs, implementation costs, and other factors may lead the State to better candidates in the future.

- ***VHF High Band (138-174 MHz) Voice Radio –*** This band of spectrum is well suited to public safety needs. Propagation characteristics in this frequency band allow for fewer required sites as VHF signals carry farther than signals at higher frequencies. Although this band is currently licensed to capacity, VHF High Band remains a viable option for many agencies currently in this band and more channels will be made available through the process of narrowbanding. Also, migration to the use of trunking technology will provide more efficient use of existing allocations with the incremental ability to expand existing channel use.

- ***Satellite Voice Communications –*** To support voice communications in very remote areas, where it is not feasible to install a permanent backbone, satellite communications will be utilized. Currently, Geo-stationary Earth Orbit (GEO) satellites provide the bulk of this type of communication capability, however, as Low-Earth Orbit (LEO) satellite systems reach maturity, they will also be used to provide remote area communications.

- ***Dedicated Mobile Data Systems –*** A dedicated mobile data network will support wireless data transactions between mobile units and fixed computer systems. This network, implemented in parallel with the voice radio communications systems, uses conventional technology and provides mobile data coverage in the same areas as voice radio coverage to supplement voice communications.

- ***Satellite Mobile Data –*** Satellite mobile data communications systems use Geo-stationary or Low Earth Orbit units to support data transmissions. Satellite communications are appropriate for use in remote areas where wireless radio system

coverage is incomplete due to the costs associated with upgrading coverage in areas of very low usage.

Operational Systems Descriptions

The voice radio systems will provide the following:

- ***Coverage*** – The systems will provide universal radio coverage throughout the State's primary service areas. The term "universal coverage" is meant to imply the inherent ability to roam within State boundaries and maintain contact with the primary system. However, due to the very high costs that would be associated with "blanket" State coverage, the notion of universal coverage should be tempered to reflect an "optimized" coverage area. Optimized coverage can be defined as coverage where users can expect permanent backbone in well-traveled areas and the potential use of temporary/mobile communications infrastructures in seldom traveled areas.

- ***Connectivity*** – Users will be able to gain system access from anywhere in the State on any portion of the hybrid backbone, regardless of whether they operate either VHF High-Band or 800 MHz equipment.

- ***Configuration*** – The primary system will be a hybrid of both VHF High-Band and 800 MHz infrastructure. The VHF High-Band infrastructure will provide coverage throughout the State, but the 800 MHz infrastructure will only provide coverage in the more urban areas (approximately two-thirds) of the State. This configuration will provide 95% coverage reliability throughout approximately 80% of the State's total geographic area.

- ***System Interface*** – Gateways will support communications between dissimilar systems. During agency transitions to the new technology, gateway use will maintain connectivity with areas not yet transitioned. For agencies operating in different frequency bands, the gateways will provide the "seamless" interconnectivity that is now lacking between the State's public safety/services agencies. These same gateways would provide interoperability with local and federal agencies.

The mobile data system will provide the following:

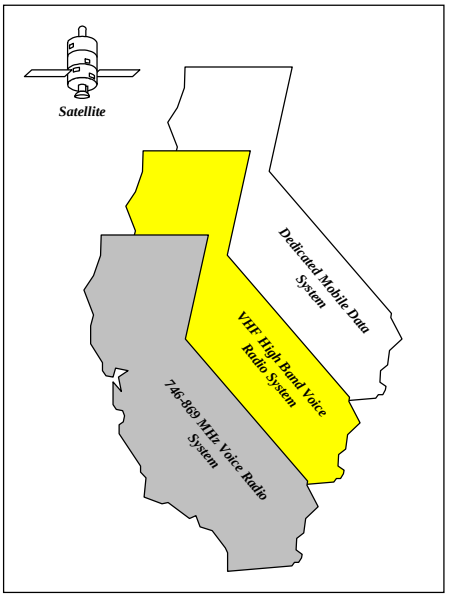
- ***Universal mobile data coverage throughout the primary service areas of the State –*** The mobile data system will be implemented in tandem with the voice system and will yield a cost avoidance derived from hardware installations for both systems being accomplished during one site development cycle.

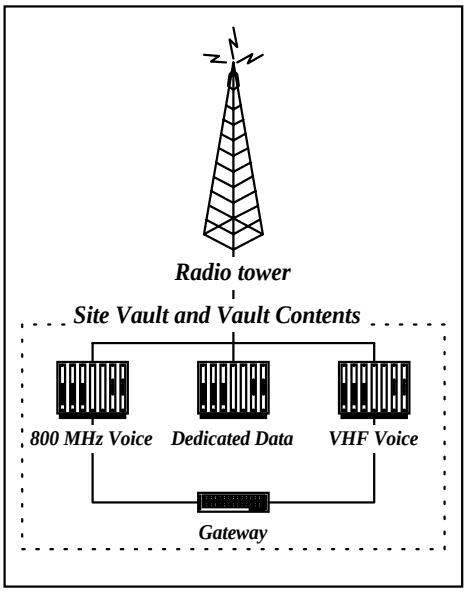
- ***Access to the data system upon implementation of the voice radio system*** – The mobile data system will be available for users immediately upon completion of the initial hybrid system implementation. It will not require the same roll-out period as the voice system since there are no existing data systems to replace.

- ***Supplement of the data system by a satellite system*** – Some agencies will require this method of data access. Costs will be borne by the agencies needing such services.

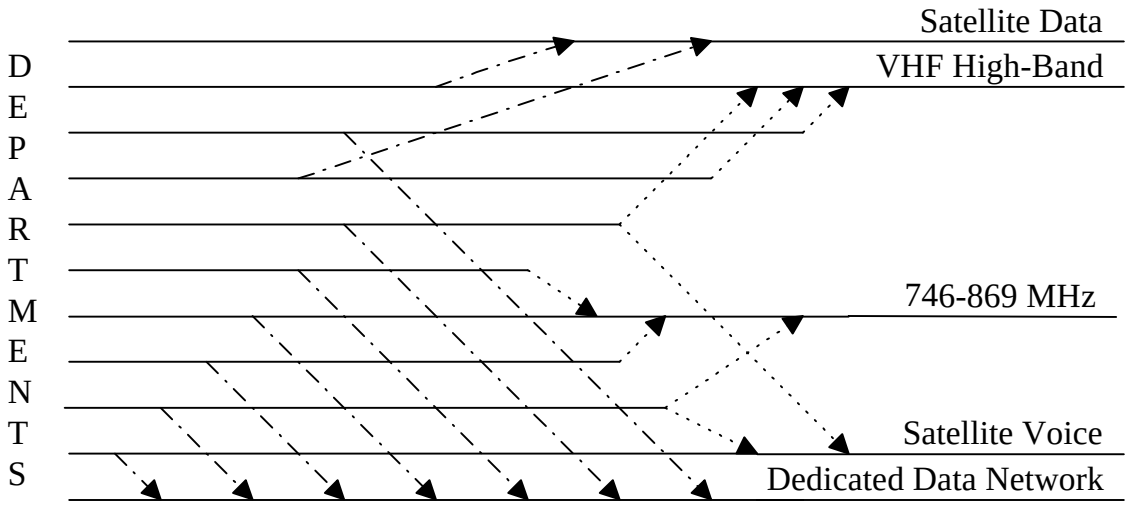
- ***Intercommunications capability between the mobile data and satellite data systems*** – An interface will be established to link the terrestrial data system and satellite data systems together for seamless interconnectivity.

The diagrams shown below represent the concept behind statewide use of the proposed hybrid system. Consider that existing departmental systems are the point from where the migration will begin.





CHP faces the most immediate need to replace its existing user equipment and is the Department that would likely transition its operations onto the new backbone first. The



implementation of this hybrid backbone would initially be designed to support CHP requirements, with sufficient expansion capability built in to support the other participating Departments when it becomes time for these Departments to migrate their operations onto the new backbone. This strategy is described in detail in Section C, Implementation Strategy (p. II-8). Potential system migration paths are shown below. Although the lines indicating the migration paths do not meet in the future, this is not meant to represent systems that will never interface. Parallel lines simply indicate the existence of primary systems, in different frequency bands, which will share interoperability by means of gateways.

The above depiction illustrates the primary systems and the potential migration paths for the participating Departments. Other support agencies, which also require a small amount of radio communications, are not shown here. The lighter dashed lines indicate voice system migration paths, and the heavy dashed lines represent mobile data system migration paths. Exhibit II-1 shows a more detailed depiction of the areas in the State in which the hybrid portions of the backbone will reside. Department unique migration paths can then be surmised by observing the radio infrastructure that exists in a particular region.

C. IMPLEMENTATION STRATEGY

The majority of the State's public safety agencies will not transition immediately from independently owned and maintained systems to shared systems. Rather, this transition will take place over the course of several years. To fully use the serviceable life of existing equipment, agencies will migrate when their equipment becomes obsolete and cost effective to replace. This section discusses the concept of equipment life cycles and outlines an approach for agency migration to shared systems in a cost-effective manner.

Radio Equipment Life-Cycle

Industry accepted estimates for the useful life of various types of radio equipment are:

- ***Fixed equipment (remote sites, etc.)*** – 12 to 15 years.
- ***Mobile equipment (mounted in vehicles) –*** 7 to 10 years
- ***Portable equipment (hand-held)*** – 5 to 7 years

Equipment replacement must occur as various components approach the end of their useful lives. At this point, purchase of equipment that is compatible with the new hybrid trunked systems should occur.

Data Systems

Concurrent development of the voice and mobile data systems will minimize costs and make both systems available at the same time. Designed for mobile (only) access, the mobile data system requires fewer sites than the voice system, which also must provide adequate portable radio coverage.

Migration Timeframe

Based on the useful life expectations listed above, the 10 participating Departments have projected the percentage of existing radio equipment that requires replacement over the project lifecycle. Once the hybrid system is established, agencies will transition operations when their end-user equipment needs replacing. This transition requires detailed planning to minimize costs and operational disruption. Complete transition may take upwards of 10 to 12 years in order to maximize the existing equipment's useful life expectancy, and to account for the fact that Departments have not synchronized their purchases of radio equipment, thus creating a staggered time period during which equipment costs are fully amortized.

Exhibit II-2, Agency Equipment Migration Schedule, shows the details associated with this migration timeframe. It also identifies the preliminary decision points at which the agencies could initiate a migration to the hybrid system. Decision points are reached when the majority of a Department's statewide inventory of user equipment is scheduled for replacement. For example, a Department may need to replace 45% of its user equipment within the first five year interval, and another 45% by the end of the second interval, or approximately six to ten years from now. The decision point to migrate to the new hybrid system will fall within that ten-year period, an interval that parallels typical equipment lifecycles. In another example, a Department may need 70% of its equipment replaced by the end of the first five-year interval. This suggests that the Department last purchased "new" equipment more than five years ago, and has more fully realized the cost benefits of that purchase. At this point, that Department is in line to migrate operations onto the new hybrid

backbone at an earlier date than other Departments which recently purchased "new" equipment.

While the Departments migrate to the hybrid system, there will be periods when the existing systems are incompatible. Gateways are needed to provide compatibility with existing systems during the transition period. At the end of the equipment replacement cycle, the participating agencies will operate on the hybrid system and will have direct compatibility because they will be operating on like frequencies with like technologies. Gateways installed during the initial phases of the project will continue to provide an interface between disparate State systems and other local or regional public safety systems.

D. ECONOMIC ANALYSIS

The following section presents an overview of the projected one-time and recurring costs associated with the implementation of shared, statewide communications systems. The total expected costs for the project and the timeframe for when the costs will be realized are both discussed.

One-Time Costs: Backbone and User Equipment

Implementation of the hybrid radio backbone will require that approximately 80% of the total fixed equipment be installed by the end of the project's first five-year interval. This will be necessary to support the migration of CHP, the first Department to make the transition. This five-year interval would begin following completion of contract negotiations. The remainder of the fixed equipment would be installed during the second five-year interval. User equipment would be purchased by the individual Departments in accordance with their own equipment replacement schedules, and would take place over the entire course of the project lifecycle.

Costs for the shared system are detailed in Appendix C. The estimated costs, for both fixed and user equipment, are described as well as the assumptions made with regard to each line item. The one-time costs associated with implementation of a hybrid voice radio backbone, for statewide public safety agency use, are shown to range from $726 million to $1.071 billion. Mobile data radio backbone costs are shown to range from $136 million to $189

million. The table below indicates the upper end of the total backbone costs associated with the project's first two five-year intervals:

One-Time Backbone Costs	
Project Interval and Percent of Total	**Costs**
First 5-Year Interval: 80%	$1,008,000,000
Second 5-Year Interval: 20%	$252,000,000
TOTAL	***$1,260,000,000***

To ensure the backbone is installed in a timely manner, the funding mechanisms to support the above figures must be identified by the time contracts are signed. An initial project timeline, shown in Section IV, Exhibit IV-1, indicates this may be as early as the year 2002.

One-time costs for user equipment will be realized only when it is time for a Department to transition onto the new hybrid backbone. These one-time costs, for each Department, are shown in Exhibits II-3 to II-6. The first three exhibits show one-time costs for voice radio user equipment, and the last exhibit (II-6) shows one-time costs for mobile data user equipment. These exhibits depict the costs for each individual agency to replace its existing equipment during the five-year intervals that comprise the overall migration plan. The first interval would begin upon completion of contract negotiations for implementation of the backbone. In the case of mobile data radio, the costs reflect initial investments, not replacements. The following table shows a summary of the one-time costs for voice radio, user equipment:

One-Time Costs: Voice User Equipment			
Agency	**Years 0 – 5**	**Years 6 – 10**	**Years 11 – 15**
CHP	$57,000,000	$14,200,000	
CDC	5,200,000	40,800,000	5,200,000
DFG	2,500,000	4,600,000	
CDF	6,500,000	25,900,000	
DOJ	12,000,000	1,500,000	1,500,000
DPR	2,400,000	8,300,000	1,200,000
DOT	6,300,000	50,600,000	6,300,000
DWR	1,100,000	2,600,000	
CYA	700,000	5,800,000	700,000
OES	800,000	3,400,000	

One-Time Costs: Voice User Equipment			
Agency	**Years 0 – 5**	**Years 6 – 10**	**Years 11 – 15**
TOTAL	***$94,500,000***	***$157,700,000***	***$14,900,000***

Other costs, which must be included with the one-time costs, are the costs associated with systems implementations, e.g., installation/integration fees, training fees, contingency funds, etc. After adding these services to the one-time equipment costs, the total one-time system costs are shown to range from $1.490 billion to $2.111 billion.

Recurring Costs

In addition to the project's one-time costs are the annual recurring costs that can be expected throughout the lifecycle of the project. The 15-year recurring costs associated with the implementation of a shared, hybrid, statewide radio system, are shown in Appendix C to range from $1.215 billion to $1.393 billion. In turn, the total 15-year project costs are shown to range from $2.706 billion to $3.504 billion. By contrast, Appendix D details the costs associated with a scenario where each Department implements its own independently operated system, and shows a 15-year total systems implementation cost range from $3.216 billion to $4.299 billion. Thus Alternative 3, the proposed alternative (Agency System Sharing), provides a platform that considers Department needs, just as Alternative 2 (Independent Agency Initiatives) does, but it potentially could provide cost savings of approximately $795 million over the Alternative 2 approach.

The following table shows a summary of the individual cost components, as described in the above paragraphs. As discussed, 80% of the backbone costs would be expended during the first five-year interval of the project, with the remainder to be expensed during the second five-year interval. User equipment costs, however, are unique to each Department, and funds for these items would be required as system migrations occur.

Item	Cost
Hybrid 800 MHz/VHF High-Band Voice Radio Backbone	$1,071,317,500
Dedicated Mobile Data Backbone	188,724,000
Total Backbone	***$1,260,041,500***
Total Voice Radio User Equipment (All Agencies)	$266,969,000
Total Mobile Data User Equipment (All Agencies)	161,735,960

Total Implementation Costs	421,955,000
Total Other One-Time Costs	***$850,659,960***
15-Year Recurring Costs	$1,392,844,000
Total 15-Year Costs	***$3,503,545,460***

It must be stressed that these cost estimates are for initial budgeting purposes. They are based upon an overall conceptual design that could change with detailed engineering analysis. The actual spectrum range chosen to support the final system design, and actual technology deployed for the system, will also impact the cost estimates.

E. BENEFITS

The benefits of implementing shared systems reflect directly upon the State's objectives defined in Section I of this document. These benefits include:

- ***Increased ability of public safety professionals to accomplish their missions*** – Comprehensive, shared radio communications systems will increase operating efficiencies for all the participating agencies. Risks to field personnel decrease as faster access is gained to vital information. State-of-the-art digital and trunking communications systems provide rapid access to information and resources that enhance personnel safety and allow the agencies to better accomplish their missions. In turn, the public will be better served by public safety personnel who are more effective and productive.

- ***Improved ability to directly interoperate with mutual aid cooperators*** – Shared systems will allow agencies to communicate directly with their mutual aid partners without requiring the use of multiple radios or complex technical solutions. Interagency coordination is made easier by a reduction in equipment, and information is more easily transferred in a direct fashion with fewer errors and delays. By enabling direct interoperability among participating agencies, the public will receive better coordination of public safety services.

- ***Faster, more accurate access to information*** - The shared data system promotes the rapid, direct transfer of information to personnel in the field and among agencies. Direct data access removes the potential for errors in transmission. This direct information transfer promotes greater operating efficiencies, thereby increasing service levels to all people supported by the participating agencies.

- ***Ability to reduce channel congestion*** – By combining operations onto fewer systems, the State's radio users will enjoy the benefits of operating in a trunked environment, where access to channels is improved. Trunking helps reduce

channel congestion by providing the ability to dynamically manage channel resources while maintaining operational separation among user agencies.

- ***Improved cost effectiveness*** – Through a reduction in spare parts inventories and a reduction in the types of equipment requiring service, operating costs will reduce by maintaining shared systems. By reducing the types of equipment requiring maintenance, the overall training required for maintenance providers will decrease. Thus, the cost associated with supporting a qualified maintenance force will reduce. Consolidation of sites means fewer trips to separate locations, improving the use this staff.

  When agencies using the hybrid system no longer require capital to replace their own independently operated backbone equipment, significant cost avoidance will be realized. Initial capital investment will provide the foundation for State agencies to replace user equipment only as opposed to both user and fixed equipment when these system components reach the end of their useful lives.

- ***Ability to support continued system growth through the deployment of mobile data –*** As the number of radio users increases, there will be more and more demand for voice communications channels. Using shared data systems will provide capability for voice communications by moving routine traffic onto a more efficient medium (digital transmission).

In summary, by implementing shared systems, as opposed to maintaining the status quo or implementing independent systems, the State will gain the following:

- Improved radio (voice communications) coverage
- Improved levels of interoperability
- Acquire spectrum allocations to meet present and future needs
- Acquire statewide mobile data coverage
- Avoid costs of expanding individual agency systems
- Avoid system obsolescence due to lack of vendor support

By meeting agency needs through implementation of shared systems, the State will improve its public safety agencies' ability to serve citizens and visitors.

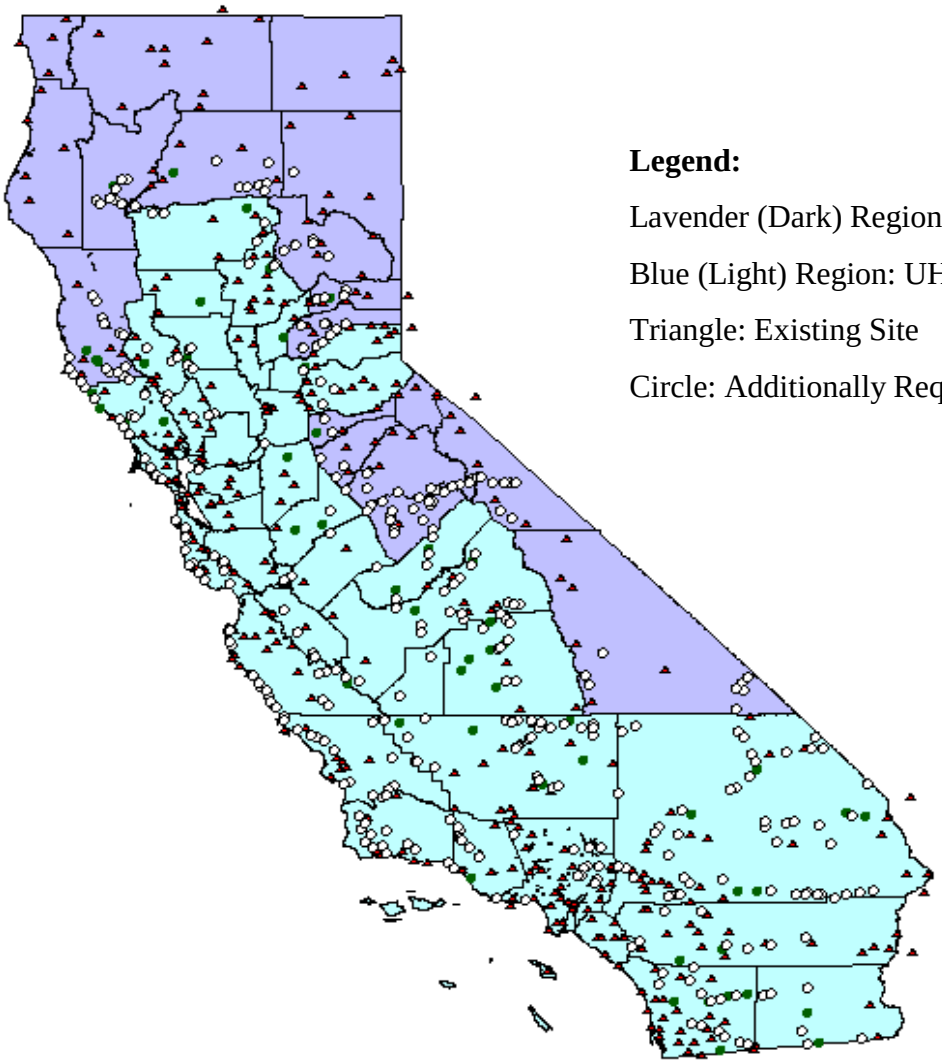
PROPOSED ALTERNATIVE

EXHIBITS

THE WARNER GROUP

Hybrid Backbone Configuration

Exhibit II-1



Legend:

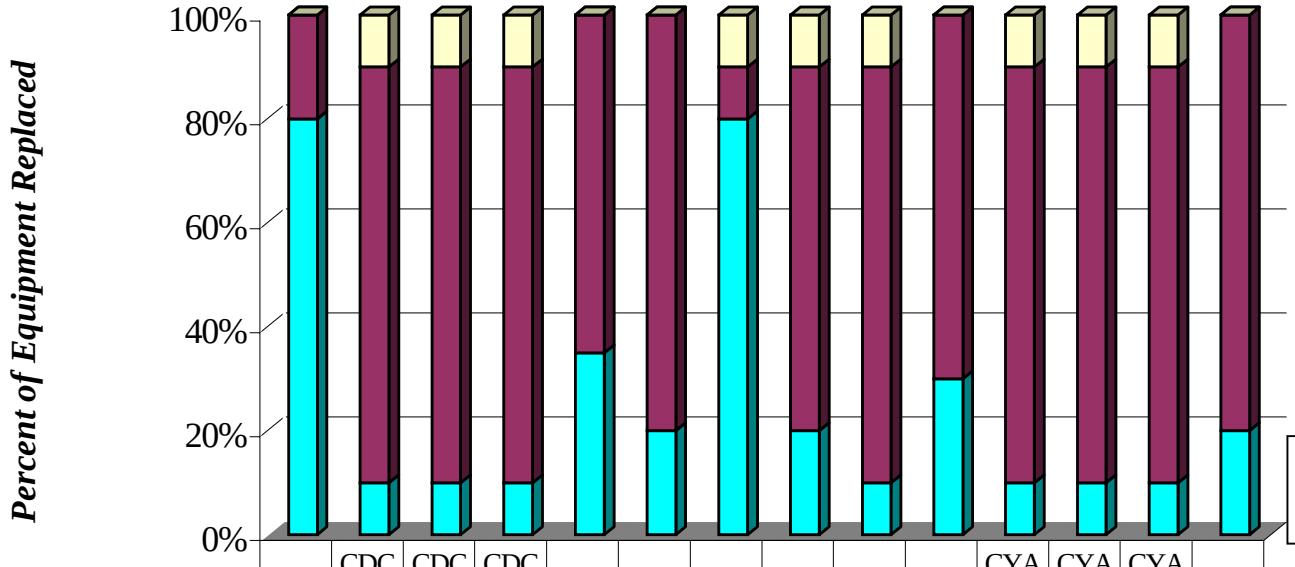
Lavender (Dark) Region: VHF High-Band Only

Blue (Light) Region: UHF and VHF High-Band

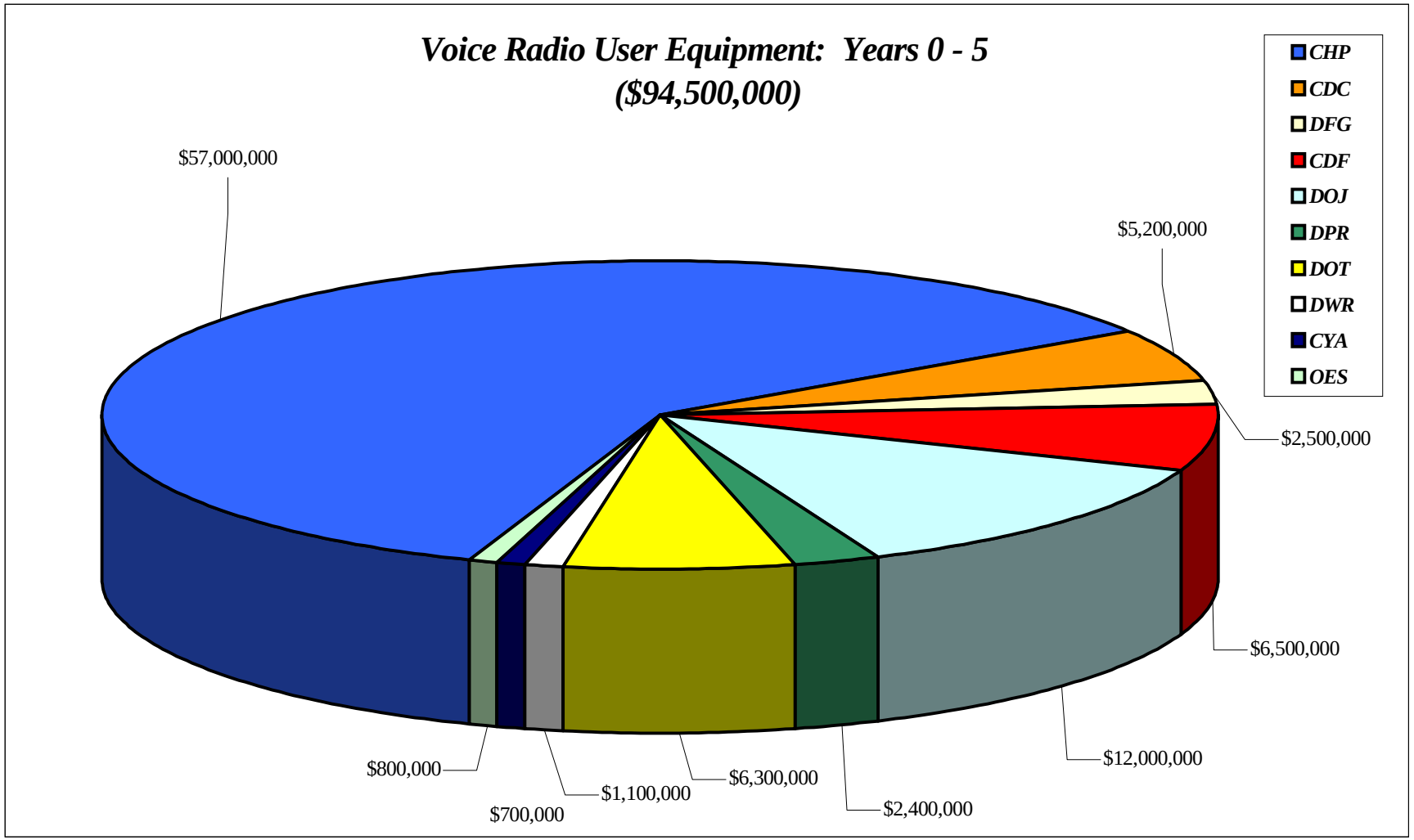
Triangle: Existing Site

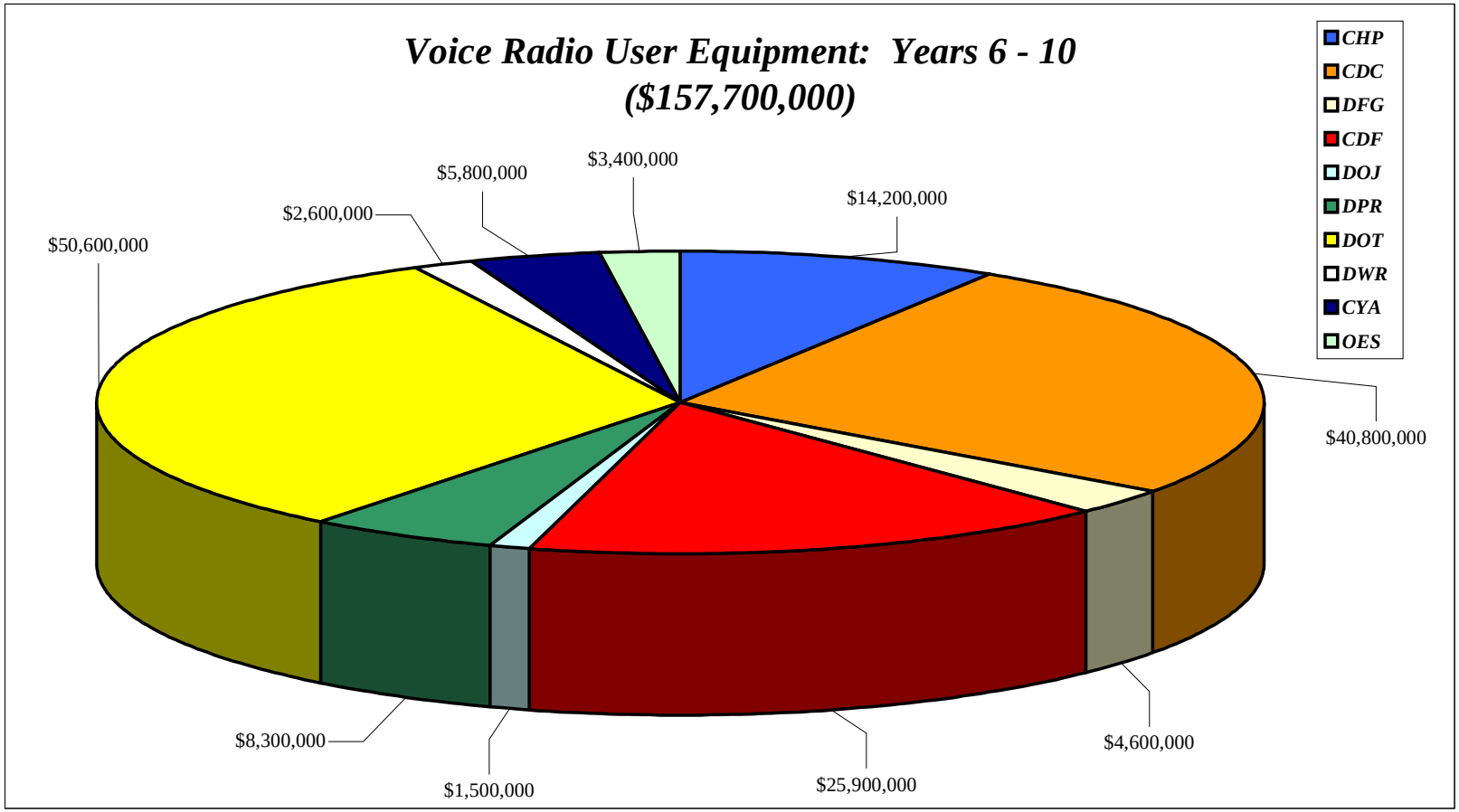
Circle: Additionally Required Site

Agency Equipment Replacement Schedule



	CHP	CDC (I)	CDC (P)	CDC (T)	DFG	CDF	DOJ	DPR	DOT	DWR	CYA (I)	CYA (P)	CYA (T)	OES
% Replaced: 11 - 15 Yrs	0%	10%	10%	10%	0%	0%	10%	10%	10%	0%	10%	10%	10%	0%
% Replaced: 6 - 10 Yrs	20%	80%	80%	80%	65%	80%	10%	70%	80%	70%	80%	80%	80%	80%
% Replaced: 0 - 5 Yrs	80%	10%	10%	10%	35%	20%	80%	20%	10%	30%	10%	10%	10%	20%


Voice Radio User Equipment: Years 0 - 5
($94,500,000)
CHP
CDC
DFG
CDF
DOJ
DPR
DOT
DWR
CYA
OES
$57,000,000
$5,200,000
$2,500,000
$6,500,000
$12,000,000
$2,400,000
$6,300,000
$1,100,000
$700,000
$800,000


Voice Radio User Equipment: Years 6 - 10
($157,700,000)
CHP
CDC
DFG
CDF
DOJ
DPR
DOT
DWR
CYA
OES
$14,200,000
$40,800,000
$4,600,000
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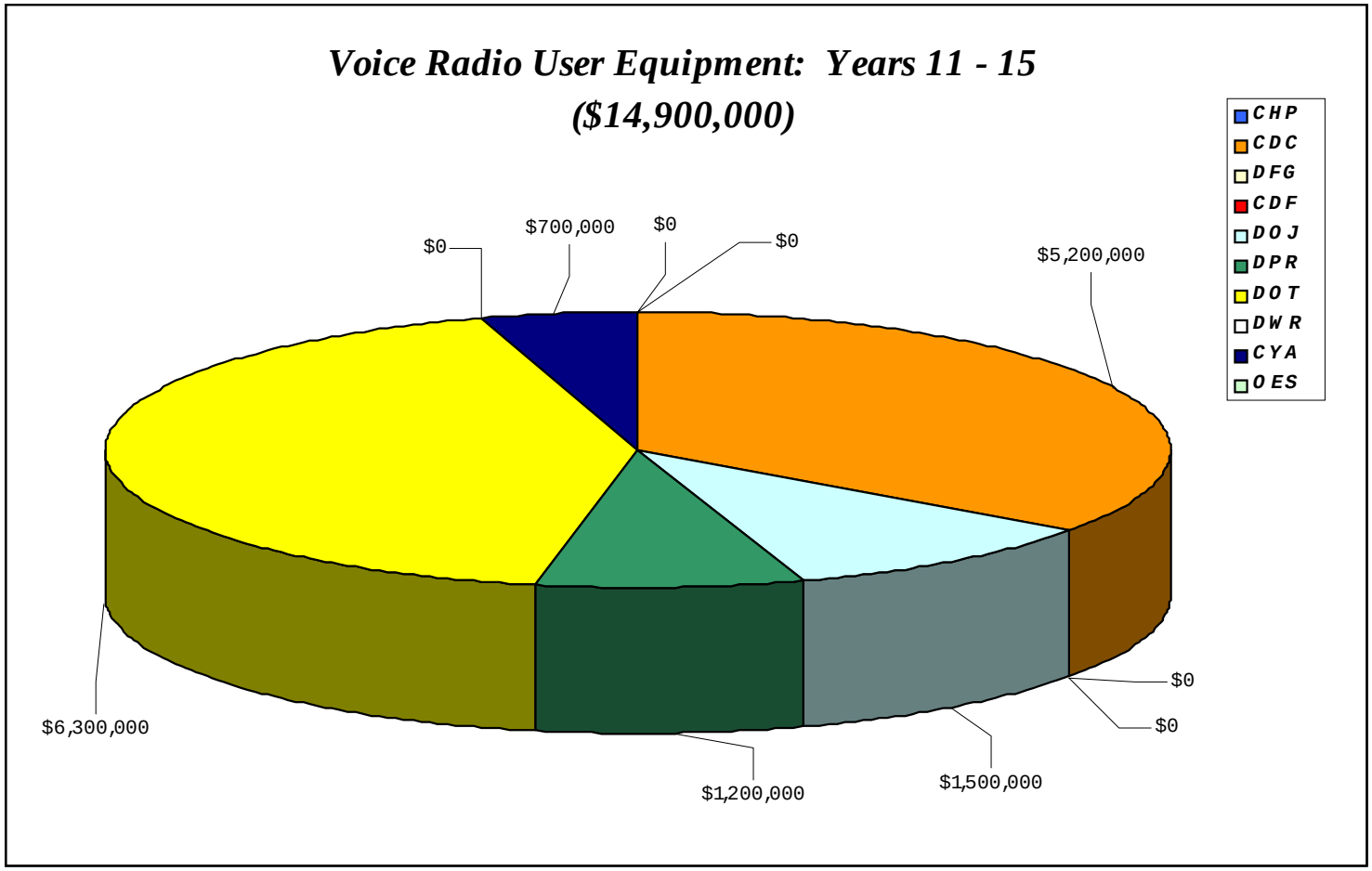
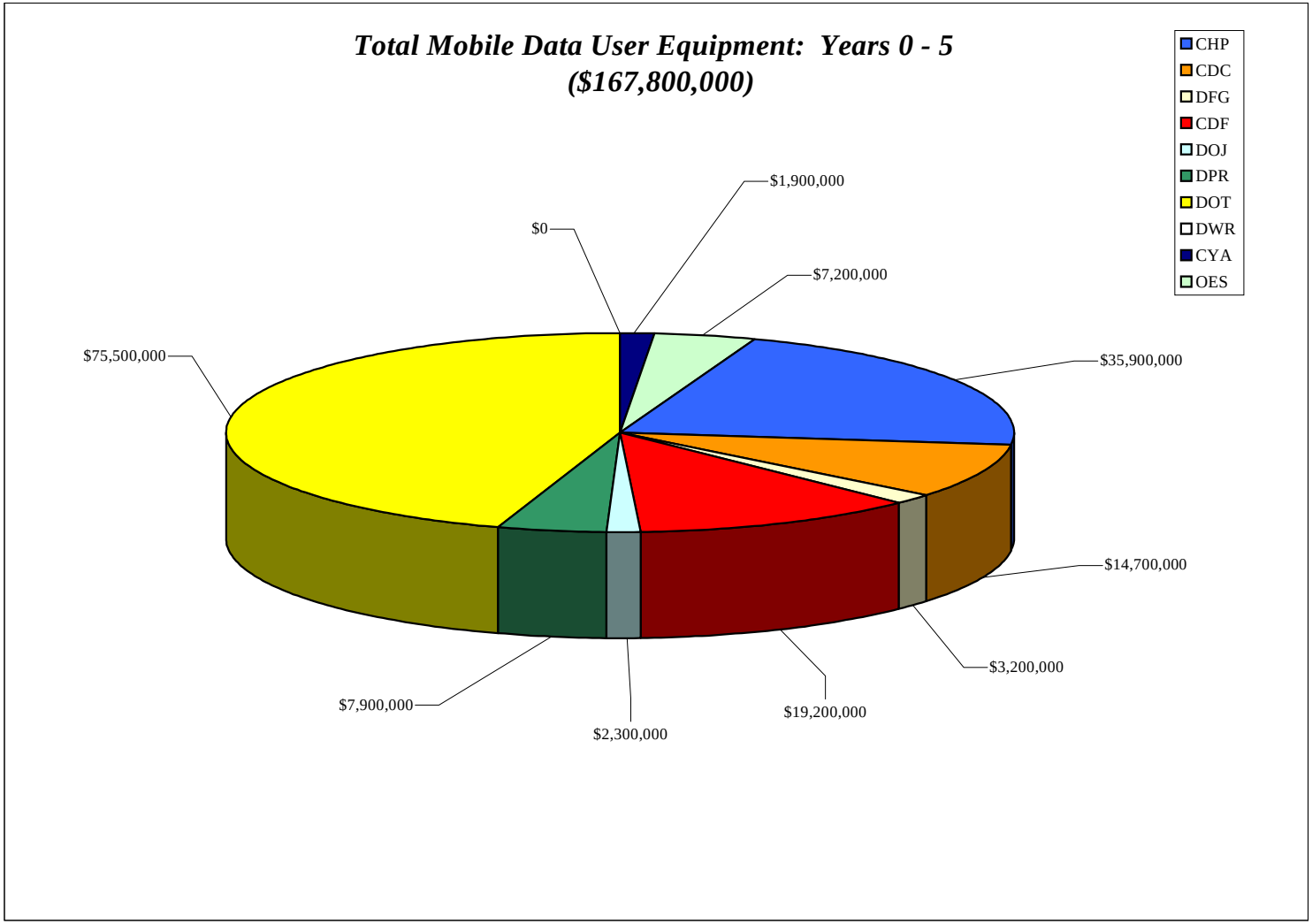
$2,600,000
$5,800,000
$3,400,000


Voice Radio User Equipment: Years 11 - 15
($14,900,000)
CHP
CDC
DFG
CDF
DOJ
DPR
DOT
DWR
CYA
OES
$0
$700,000
$0
$0
$5,200,000
$0
$0
$1,500,000
$1,200,000
$6,300,000


Total Mobile Data User Equipment: Years 0 - 5
($167,800,000)
CHP
CDC
DFG
CDF
DOJ
DPR
DOT
DWR
CYA
OES
$1,900,000
$0
$7,200,000
$75,500,000
$35,900,000
$14,700,000
$3,200,000
$19,200,000
$2,300,000
$7,900,000

SECTION III

ANALYSIS OF ALTERNATIVES

THE WARNER GROUP

III – ANALYSIS OF ALTERNATIVES

A. INTRODUCTION

This section provides an analysis of the alternatives available for meeting the State's public safety radio communications objectives and requirements. Numerous technical options were evaluated to determine which alternative best meets the needs of California's State public safety agencies. Specifically, three alternatives were identified and evaluated.

1. ***Baseline Alternative*** – Assumes that no significant changes are made to current agency system configurations and that no new systems will be implemented.

2. ***Individual System Initiatives Alternative*** – Assumes that the unmet needs of the public safety agencies will be addressed with individual agency and independent system efforts.

3. ***System Sharing Alternative*** – Assumes that the agencies will meet their needs by developing shared systems.

The section begins with an introduction to the methodology and process used in the evaluation of these alternatives. An overview is provided of the technological and spectrum options that were evaluated as background information. The analysis for each of the three alternatives is then discussed.

B. METHODOLOGY

The agencies' prioritized requirements are outlined in Section I of this report. Exhibit III-1 presents a one-page summary of these requirements. These unmet agency needs and requirements, especially interoperability and mobile data access, are the driving force behind the analysis that follows.

The process used to accomplish the evaluation of the three alternatives is based on an approach that is similar to a "waterfall", i.e. conclusions from one alternative are used to provide input to the next alternative. Beginning with Alternative 1, the Baseline Analysis, where the current system configurations are described, these configurations establish a starting point for all subsequent alternatives.

Addressing unmet needs as 10 independent entities forms the foundation for Alternative 2, Agency Independent Initiatives. It is in the analysis of this alternative where future configurations which support agency requirements are determined. Once conclusions are drawn regarding optimal configurations that will address agency needs independent of one another, these future configuration models are brought forward as options for the analysis of Alternative 3, Agency System Sharing. In this alternative, the same attempt to address unmet agency needs is approached by examining the future system configurations of the individual agencies and determining the optimum mix of VHF High-Band and 741-869 MHz that would best support multiple agencies. Exhibit III-2 shows a visual depiction of this "waterfall" process.

To form the conclusion as to which technology and spectrum provide the optimal solution for an individual agency's requirements, combinations of technical options were measured against their ability to provide needed capabilities. These scenarios are defined as the combinations of technical and spectrum options that could potentially meet an agency's requirements. Evaluation criteria were developed that considered each technical or spectrum option's functionality, the likelihood of availability, and the fiscal considerations associated with each. Various scenarios were evaluated against these criteria to conclude the optimal technology and spectrum solutions for each agency. Exhibit III-3 presents a visual overview of this evaluation process.

C. OVERVIEW OF TECHNOLOGY AND SPECTRUM OPTIONS

Numerous technology and spectrum options were evaluated in developing this analysis. Exhibit III-4 provides an overview of the options for voice and data technology and frequency spectrum. The ability of either a technology or spectrum option to support the prioritized requirements of each agency was a primary factor in this evaluation. In the analysis of these options, a "plus" or "minus" was awarded to a particular option to indicate its ability, or inability, to support a given requirement. A summary of the conclusions to the analysis is shown in Exhibit III-5. The following paragraphs describe how these "bottom line" conclusions were drawn and how the final "plus" or "minus" was assigned to each option.

To form a conclusion regarding an option's feasibility, it was necessary to apply a measure of subjectivity to the analysis. Where some options yield many "minuses" (some within the highest level of priority), and others yield few or no "minuses," it is necessary to carry certain options forward while discarding others. For example, the technical evaluation of a conventional radio system yields 11 "minuses" (of a potential 29), and yet the overall evaluation shows this as a "plus" and is a feasible option for that agency. This is because conventional systems are currently established for agencies which do not have the minimum number of users per channel to justify a multi-channel trunked system with the FCC. An example of an option where few "minuses" appear is that of the voice option of Specialized Mobile Radio (SMR). Only three "minuses" appear in its column, but the bottom line yields a "minus". This is because SMR vendor technology is proprietary in nature, and once implemented, an agency becomes isolated from other non-SMR public safety users. Although the option can support many of the agency's requirements, it cannot support interoperability, thereby earning a bottom line "minus." It is in this fashion that each of the options was analyzed, and consideration was given to both the ability of the option to support agency requirements and to its ability to support the project's vision of shared systems.

In analyzing spectrum options, significant consideration was given to the likelihood that a particular band of spectrum would have sufficient frequencies available for State use. For example, the FCC has allocated new spectrum to support public safety requirements. If it was deemed likely that those channels would be available, then it was awarded a "plus." If there was a strong likelihood that a particular frequency band would not have new channels available within the next 5-10 years, that option was awarded a "minus."

Additionally, if an agency was likely to have mutual aid cooperators in a particular band of spectrum, that spectrum option was awarded a "plus." For example, the Department of Forestry's (CDF) most important mutual aid partner is the U.S. Forest Service which conducts operations in VHF High Band frequencies. Thus, frequencies in other bands are not useful to CDF's interoperability requirements.

The following discussion provides an introduction to each technology and spectrum option that was evaluated.

Voice Radio Technology Options

- ***Conventional radio*** – This is the oldest and currently the most prevalent form of wireless communications. These are radio systems that are designed based on discreet frequencies dedicated to specific communications channels. A single frequency (or frequency pair for duplex communications) equates to only one usable channel. In a specific geographic region, when a user is transmitting on that channel, no other users have system access on that channel until the initial user stops transmitting. Exhibit III-6 compares the advantages and disadvantages of conventional radio systems.

- ***Trunked radio*** – "Trunking" refers to radio systems that are designed so that users "draw" a channel from a pool of licensed frequencies at a fixed site. This is similar to a voice telephone PBX system where both outbound and inbound lines are shared among telephone sets. All users assigned to the system have access to all of the channels licensed by the owner of the system. When a user acquires a channel to transmit a message, only that channel becomes unavailable to other system users for the duration of the transmission. Other channels that are part of the pool, however, are still available for use. Exhibit III-6 compares the advantages and disadvantages of trunked radio.

- ***Analog signal technology*** – Analog technology is the simplest form of radio transmissions. The earliest radios were designed to transmit analog signals. Analog signal technology is a transmission technology where voice messages are transmitted from one point to another by converting the audio signal into radio frequency signals. This is accomplished by modulation of the source signal that is analogous to the original voice. Exhibit III-7 compares the advantages and disadvantages of analog technology.

- ***Digital signal technology*** – This is a transmission technology whereby messages are transmitted by translating the analog (voice) source signal into a digital bit-stream of ones and zeroes similar to the sounds heard on a musical compact disc (CD). This stream of digital bits is then transmitted over the radio network and reconstructed at the receiving end as the audible sound. Exhibit III-7 compares the advantages and disadvantages of digital signal technology.

- ***Single side-band radio*** – Side-band transmission technology was specifically designed for spectrum efficiency by reducing the need for channel bandwidth (i.e. the amount of spectrum required to carry a signal). Single side-banding is a conventional technology in which two "side-band" radio waves are created on either side of a channel's center frequency (the mid-point of the channel's assigned portion of spectrum). A single side-band transmission uses only one-half of the bandwidth, a method that is similar to frequency division or narrow-banding. Exhibit III-8 compares the advantages and disadvantages of single side-band radio technology.

- ***Channel access technologies*** – Channel access technologies support multiple transmissions over shared communications channels. There are three generally available methods used to achieve multiple channel access: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), and Code Division Multiple Access (CDMA). Frequency division transmits many signals simultaneously at different frequencies. Time division transmits many signals at the same frequency, but at different time intervals. Code division is also known as "spread spectrum", in that radio signals are transmitted over a very broad range of spectrum. FDMA has been selected for use in the APCO Project 25 Phase I digital radio standard. Both FDMA and TDMA have been selected for the APCO Project 25 Phase II digital radio standard. Numerous PCS vendors are using CDMA for commercial wireless telephone systems. Exhibit III-9 compares the advantages and disadvantages of each of the channel access technologies.

- ***Satellite communications*** – Two types of satellite systems offer mobile communications services: Geo-stationary (GEO) and Low Earth Orbit (LEO). GEO satellites remain in a fixed position 22,300 miles above the Earth. GEO satellites have been in service for a number of years, but signals are delayed by the 44,600 miles round trip the message must travel. LEO satellites are placed in orbit between 300 to 700 miles above the Earth's surface. Exhibit III-10 compares the advantages and disadvantages of satellite communications.

- ***Cellular telephone*** – This technology differs from traditional mobile radio technology in two respects. Traditional radio utilizes high power fixed repeater sites located at high elevations in order to maximize their coverage area. Cellular technology utilizes lower-power site and directional antennas that are designed to provide coverage over a small area (or cell), thereby allowing reuse of the same frequencies in different cells. Cellular telephone service is also utilized extensively by commercial entities and the public at large. Exhibit III-11 compares the advantages and disadvantages of cellular telephone.

- ***Specialized Mobile Radio (SMR)*** – An SMR is a specially licensed private enterprise that has established a dedicated radio system and who markets land mobile communications services on a fee-for-service basis. Exhibit III-12 compares the advantages and disadvantages of using SMR providers.

- ***Gateways*** – These are intelligent fixed system devices that allow communications between dissimilar systems. In the context of voice radio, this allows a user transmitting in the VHF High Band, for example, to transmit to users operating in the 800 MHz band. The gateway permits the receiver to hear the transmission without requiring the use of multiple band radios.

Mobile Data Technology Options

- ***Dedicated mobile data network*** – A dedicated mobile data network is designed to meet the wireless data access needs between mobile units and fixed host computer systems. These networks are typically implemented in parallel with a

voice radio communications system, providing coverage in the same area as the voice system. These systems generally use conventional or trunking radio system technology. Dedicated mobile data networks are typically utilized for higher volume data application requirements or to support large numbers of users. Exhibit III-13 compares profiles of the various mobile data transport technologies.

- ***Integrated voice and data network*** – An integrated voice and data network uses the same radio communications equipment for both user equipment and fixed system equipment to transmit and receive both voice and data signals. This is accomplished by digitizing the analog voice message and interleaving it with a data message, or by supporting separate transmissions for voice and data messages. Depending on the particular technology selected, this approach offers advantages when supporting small numbers of users and a lower volume of data transaction requirements. Most integrated voice and data systems use trunking technology.

- ***Circuit switched cellular*** – Circuit switched cellular uses the existing cellular telephone networks for data transmissions. Essentially, a radio modem is attached to the mobile computer and a dial-up session is established with the host computer. This approach incurs a delay in the transmission of information while the telephone call is established. Cellular data systems are limited by the same constraints associated with "regular" cellular telephones (e.g. loss of signal when travelling through a tunnel or when out of range of a cellular site).

- ***Cellular digital packet data (CDPD) –*** CDPD uses a dedicated channel in the cellular network to transfer data. Discrete "packets" of data are transmitted over the network and reassembled at the receiving device. CDPD capability requires a system upgrade to the existing cellular telephone network, and is not generally available in the same areas as current cellular coverage, therefore, it is not a viable option for State public safety/service use.

- ***Private packet radio networks*** – Private packet radio networks are commercially provided data transmission services supported by networks that are similar to the dedicated mobile data networks. Generally, these are proprietary networks with vendors differentiated by available transmission protocols, system coverage areas, and cost of service.

- ***Enhanced specialized mobile radio (ESMR)*** – ESMR is essentially an SMR network using digital transmission technology. Since the voice messaging is digitized, data transmissions can be accommodated without additional interfaces and modems. The same fixed and user radio equipment is used for both voice and data transmission requirements. Several ESMR providers offer user equipment with integrated voice and data features, as well as alphanumeric display and paging capabilities. This form of data transport does not support multi-agency interoperability.

- ***Personal communications systems (PCS)*** – PCS is the next generation of terrestrial-based commercial wireless communications. PCS system designs are based on "micro-cellular" coverage. Micro-cells are areas which are smaller than standard cellular telephone coverage areas and use low-power transceivers. Due to the transmission technologies utilized and the greater transceiver density, these services could potentially provide significantly greater data throughput.

- ***Satellite mobile data*** – Satellite mobile data communications use many geo-stationary (GEO) or future low-earth orbit (LEO) providers to support mobile data transmissions. Satellite data system providers utilize both circuit switched and packet technologies.

- ***Enhanced paging*** – Enhanced paging provides one-way data transmissions to a radio receiver. Both alphanumeric text and binary data, such as images, can be supported by this technology. Some newer enhanced paging technologies provide for short reply message capabilities.

- ***Automatic vehicle location (AVL)*** – AVL typically uses a sensor on a vehicle to identify the vehicle's position that is then transmitted back to a centralized point such as a dispatch center. Thus, transmission of AVL position information requires a wireless data network between the vehicle and the fixed location. At the dispatch center, the vehicle's position is typically shown on an electronic map display. The vehicle's position may also be presented to the driver and passengers on an in-vehicle map display or laptop computer.

The following is a summary of the conclusions drawn, from the analysis of the technical and spectrum options, as these options were analyzed against the needs identified in Section I:

Voice Radio Technologies

Conventional vs. Trunked – Conventional technology cannot support many of the priority requirements identified by each agency. Examples of requirements not supported by conventional technology include both "call" and "unit" prioritization, flexibility of grouping of users, and granting immediate channel access. Trunking technology promotes system efficiency since fewer channels are required to support a greater number of users. Conventional and trunking systems can co-exist, with portable and mobile equipment being mutually compatible. *Conclusion: Trunking technology better provides for the State's needs although it is relatively expensive in low user-density areas, where conventional systems may be installed instead.*

Trunked Channel Access Methods – Of the three means of providing shared channel access when operating in a trunked mode, each (TDMA, FDMA, CDMA) corresponds with proprietary technology. All three methods can be applied to the public safety environment and all three are capable of supporting requirements. *Conclusion: Any channel access method is acceptable as long as it provides interoperability between agencies, regardless of the equipment purchased and installed.*

Analog Signal vs. Digital Signal – Although analog signal technology can support agency requirements, most vendors are changing their product lines to digital. Digital technology offers a wider array of features than analog technology does, and can more easily comply with potential mandates regarding the efficient use of spectrum. It is expected that most analog equipment will be replaced with digital equipment in the future. *Conclusion: Digital signal technology better suits the State's needs.*

Single Side-Band Radio (SSB) – SSB radio supports almost all agency requirements; however, due to problems with signal reception in both the mobile and portable environments (due to low power transmissions), few agencies make use of this technology. Hence, the likelihood is low that interoperability requirements will be satisfied via this technology. *Conclusion: Single Side-Band radio technology does not meet the State's needs.*

Satellite Based Voice Mobile Communications – Data gathered during a recent Request for Information (RFI) sent to several satellite communications vendors indicates that satellite platforms are not currently viable alternatives for satisfying the State's primary public safety radio communications needs. The following identifies the key shortcomings of currently available GEO satellite systems:

- No portable (i.e., hand-held) access
- Significant time delay between transmission and receipt of message
- Poor in-building coverage
- Single point of failure (i.e., only one satellite, with no redundancy, to support all users)

LEO systems are being launched, but cannot be considered a viable alternative for several years to come. Currently, of the 8 vendors planning for LEO systems, none are positioning themselves to provide dispatch (i.e., one to many) capability. These new systems target the mobile telephone market, and will provide wide-area "roaming" capabilities similar to a typical cellular telephone service. For example, one vendor is offering a dispatch service from a GEO platform, but the configuration lacks other capabilities to meet the State's requirements (such as system access with portable radios). *Conclusion: Satellite communications are not a viable option for primary public safety communications at this time; however, their unique features make them a viable alternative for secondary and ad-hoc communications requirements.*

Cellular Telephone System Use – Cellular telephones do not satisfy agency requirements for priority access and availability and cannot be considered as a primary means of voice communications for public safety agencies. They can, however, be a valuable backup to radio communications in areas where coverage permits their use. Cellular telephone coverage is comprehensive in most urban and many suburban areas, but is currently limited in remote areas. *Conclusion: Continue cellular telephone use as an adjunct to public safety radio communication capabilities.*

Specialized Mobile Radio Providers (SMRs) – These providers supply a valuable service; however, they fall short when considering the requirements for providing

interoperability and statewide coverage. The likelihood of other government users (either federal, State, or local) operating on the same system provided by the SMR is not great, and therefore, interoperability will suffer. *Conclusion: The State should not pursue the use of SMRs for primary public safety voice radio communications.*

Mobile Data Technologies

Dedicated Mobile Data Network vs. Integrated Voice and Data Network – Integrated voice and data systems tend to operate less efficiently than dedicated systems because of the inefficiency of trunking data messages with voice messages. A dedicated data network will prove more cost effective since numerous fixed sites, vaults and towers will already be established for voice communications systems. *Conclusion: A dedicated mobile data network better suits the State's needs while simultaneously addressing system cost concerns.*

Circuit Switched Cellular (CSC) – Circuit switched cellular has the disadvantage of longer set-up time, as the data device must await connection through the cellular telephone public switched network. Immediate access to or receipt of information is delayed. Coverage for data uses mirrors that for cellular telephone applications, thus is only available in urban areas and along major roadways. *Conclusion: CSC is not a preferable means of data transport for the State, especially not for agencies which operate in rural or wildland areas.*

Cellular Digital Packet Data (CDPD) – CDPD is slowly becoming more available across the nation as a means of transport for mobile data messages. Many vendors are beginning to offer fixed-rate contracts for public safety users; however, this technology is also supported by the cellular telephone network and may be affected by the same coverage limitations that affect switched cellular telephone services. *Conclusion: CDPD is not a preferable means of data transport for the State,.*

Private Packet Radio Network (PPRN) – This technology demonstrates favorable performance characteristics for medium-bandwidth (e.g. image transmissions) public safety applications. As a privately owned and run network, a vendor would also have direct responsibility for system maintenance and administration. *Conclusion: PPRN is well suited to support State mobile data requirements where it is consistently available; however, availability is generally limited to areas of higher population density.*

Enhanced SMR, Personal Communication System (PCS), or Satellite Mobile Data – ESMR has similar characteristics to an integrated voice and data system, thus it is not a desirable means to support State requirements. Satellite data rates are typically slow, with most "patrol fleet" mounted mobile data systems only being capable of up to 4,800 baud. PCS could be a viable means to address requirements for mobile data, but until vendors have finished building out their systems, exact costs and system coverage is not available for evaluation. *Conclusion: PCS-based mobile data communications may be a viable option in the future if coverage is available and it proves to be cost effective.*

Automatic Vehicle Location (AVL) – AVL technology is a mature, stable product offering which can be integrated with each of the data transport technologies. *Conclusion: AVL should be implemented for all agencies.*

Spectrum Options

VHF Low Band – Due to the operational deficiencies and the inability to support date capability, few public safety radio vendors are supporting or manufacturing equipment that will operate in this frequency band. Only a limited number of public safety agencies use equipment that operates in this range; therefore, interoperability requirements are unmet through use of this spectrum. *Conclusion: VHF Low Band will not support agency requirements*

VHF High Band – Agency requirements for both voice and data can be supported by continued use of this frequency band. VHF high band provides optimal coverage for public safety agencies activities because of its propagation characteristics; however, it is unlikely that additional channels will be available in the VHF band within the next fifteen to twenty years. Numerous fire suppresqion and emergency response agencies operate in this band. *Conclusion: The State should maintain VHF High Band radio system capability, where it is currently used, with coverage and technology upgrades as required.*

220 MHz Band – Although this frequency band is technically capable of supporting agency requirements, it is not a frequency band in which other public safety agencies operate, nor are new frequency allocations expected in this band. Thus, interoperability requirements are not be supported by using this frequency band. *Conclusion: 220 MHz band frequencies do not provide sufficient opportunities for State needs and, therefore, are not suitable to support statewide communications.*

UHF Band – Many public safety agencies already operate in this band of spectrum in both urban and rural areas of the State. There are no indications that any new allocations will be made for public safety use in the near future. *Conclusion: UHF does not provide sufficient opportunities for State needs and, therefore, is not suitable to support statewide communications.*

UHF-T Band – Initially allocated to provide relief from channel congestion in the major urban centers of the nation, additional waivers would be necessary to use these channels on a statewide basis. *Conclusion: UHF-T channels are difficult to acquire, but are a potential source of spectrum for State needs.*

746 – 806 MHz (TV Channels 60 – 69) – The FCC has allocated 24 MHz of new spectrum from this frequency band for public safety use. At this time, this band represents the best chance for the State to acquire additional frequency allocations. However, The FCC is in the process of refining these requirements regarding the use of this spectrum, and the potential for its use by the State is somewhat dependent on the outcome of these requirements. At this point in time, the 746-806 MHz spectrum appears to be the best candidate for use by public safety agencies in the State, however,

user needs, implementation costs, and other factors may lead the State to better candidates in the future. *Conclusion: This band provides the most promise of new frequency allocations for public safety use.*

800 MHz Band – Several State and local agencies have established systems in this band. The allocations in the TV channel 60-69 range are contiguous with the current 800 MHz public safety allocations (806 – 869 MHz). Vendors are likely to consider developing radios that are compatible with both spectrum allocations. Thus, it will benefit agencies to continue building-out systems and acquiring equipment that operates in this frequency band. *Conclusion: The State should maintain 800 MHz voice radio system capabilities.*

D. ALTERNATIVE 1 – AGENCY BASELINES

Alternative 1 assumes that current configuration of technology and use of spectrum remains the same, i.e., status quo. Agency systems operate independent of one another (very little direct interoperability) and are maintained with no significant capital improvements.

A profile of each agency's existing systems and current fiscal year costs is presented in Appendix B. The profile also provides a description of the frequencies utilized (both primary and mutual aid), the numbers of facilities and equipment, and the approximate age of equipment. User equipment is generally replaced on a five to seven year cycle and fixed radio equipment is replaced on a twelve to fifteen year cycle. Frequency sharing agreements with local and federal public safety agencies are also provided to emphasize the interoperability requirements of the agencies.

The costs presented below reflect a snapshot of the current fiscal year budgets, including approved Budget Change Proposals (BCPs) for each of the agencies.

AGENCY	EXISTING SYSTEM DESCRIPTION	FY 1997- 98 BUDGET
CHP	Conventional, VHF Low-Band Voice; SMR Data	$27,067,000
CDC	Conventional & Trunked, VHF High-Band & 800 MHz Voice; No Data	5,050,000
DFG	Conventional, VHF High-Band Voice; No Data	1,555,000
CDF	Conventional, VHF High-Band and Low-Band Voice; Satellite Data	10,700,000
DOJ	Conventional, VHF High-Band Voice; No Data	534,000
DPR	Conventional, VHF High-Band & 800 MHz Voice; No Data	3,360,000
DOT	Conventional & Trunked, 800 MHz Voice; No Data	10,413,000
DWR	Conventional, VHF High-Band Voice; No Data	2,014,000
CYA	Conventional & Trunked, VHF High-Band & 800 MHz Voice; No Data	1,020,000
OES	Conventional, VHF High-Band Voice; Satellite Data	1,672,000
	TOTAL	***$63,385,000***

Although Alternative 1 is the least costly alternative considered, it is not a viable option for the following reasons:

- ***Agency needs not addressed*** – Continued use of baseline systems does not support agency requirements, especially those for interoperability, coverage upgrades, and channel congestion relief (see Section I, Exhibit I-4, for further details).

- ***Spectrum mandates preclude continued use –*** The FCC mandates spectrum use efficiency. This will be accomplished through narrow-banding existing channels in the UHF and VHF bands of the spectrum, migration to digital systems, and migration to trunking technologies. The existing systems cannot support these mandates.

- ***Technology not supported –*** Manufacturers are moving into the environment mandated by the FCC and are no longer supporting some existing systems. Both parts and components to maintain user and fixed system equipment are no longer available. Soon these systems will become inoperable, putting the public and public safety personnel at risk.

These issues mean that the State's public safety agencies cannot maintain the status quo, but rather, must do something different. Replacement "in kind" is not possible.

E. ALTERNATIVE 2 – AGENCY INDEPENDENT INITIATIVES

Under this alternative, each agency develops its systems (both voice radio and mobile data) independently. Through an analysis of voice and data technology options, as well as spectrum options, conclusions are drawn regarding the system configuration that would best address the unmet communications needs of each Agency.

Optimal Agency System Configurations

Based on the conclusions from the analysis of the technical alternatives and spectrum options, future system configurations can be described. These system configurations represent the optimal path for each of the agencies to follow to meet their communications requirements independently of one another. The following summarizes these system configurations:

California Highway Patrol – VHF High Band and 406-869 MHz hybrid, digital, trunked voice radio system and dedicated data network: CHP requires statewide, border-to-border radio coverage and a wide degree of interoperability with State, local

and federal level agencies. CHP's numerous users require a voice radio communications infrastructure sufficient to meet their operational needs accompanied by a significant allocation of channels to support the migration from VHF Low Band to any other spectrum. By implementing trunking technology, CHP will more efficiently use these new spectrum allocations. Detailed coverage modeling by CHP has revealed the new CHP infrastructure should be developed with a hybrid backbone using both VHF and UHF bands to their greatest advantage; i.e., CHP will communicate on a VHF High Band infrastructure throughout the 18 mountainous (shaded) California counties in Exhibit II-1 titled "*Hybrid Backbone Configuration*", and on a UHF infrastructure throughout the 40 lower-level (unshaded) California counties shown in the same exhibit. This proposed hybrid will allow for any authorized interoperability amongst the system users by employing modern switching technologies. CHP plans to leverage existing facility and equipment investments to the extent practicable.

Department of Corrections – 800 MHz and VHF High Band, trunked voice radio system with dedicated data network: CDC is installing 800 MHz networks at their institutions and will use this technology to equip its transport vehicles, but it would still maintain VHF High Band capability for its Paroles division. Also, CDC would maintain VHF High Band capability to support direct intercommunications between the Department of Forestry and Fire Protection and CDC's Camps. Both Camps and Paroles will require interoperability with local agencies and will base their future system configurations on what local agencies are using. These divisions may use the CDC trunked/conventional system, or they may use the same system that the local agency uses. Typical coverage requirements for CDC are limited to the prison facilities and the transportation routes connecting these and other criminal justice facilities. System expansion is limited due to current allocations for other public safety users in the 800 MHz band. Any new allocations are projected from the 746-806 MHz band. Continued use of a system with the described configuration will, however, provide CDC with the communications capabilities it needs to accomplish its mission, but with no improvements to interagency communications or operating efficiencies.

Department of Fish and Game – VHF High Band, conventional, voice radio system with dedicated data network: A DFG system, operating independently of other agencies, would not provide the minimum number of users required to support a trunking environment (trunked systems require 70 to 100 users per channel for the FCC to grant the license), and a trunked system would not be cost effective. Mission requirements could be addressed through continued use of conventional systems, but no improvements to interagency communications or interagency operating efficiencies would be realized.

Department of Forestry and Fire Protection – VHF High Band, trunked and conventional voice radio system with satellite mobile data network: Currently, CDF maintains highly mobile and flexible radio communications systems that use spectrum bands ranging through all portions of the current allocations for public safety users. To support interoperability requirements, CDF deploys mobile command stations that provide cross-band connectivity via UHF band, VHF band, 800 MHz band, and

satellite communications. However, this agency's primary mutual aid cooperator is the U.S. Forest Service, an agency that is committed to continuing operations in VHF High Band. Therefore, to meet its own operational requirements and to support long term commitments with the U.S. Forest Service, CDF must continue to operate in the VHF High Band. The one technological change on CDF's horizon is the migration to trunking technology. While there is little expectation for new spectrum allocations in VHF High Band, trunking technology would enable improved use of existing channel allocations.

CDF also requires radio coverage throughout the State in order to respond to emergencies. Portable repeaters and mobile communications vehicles provide ad hoc communications capability.

Department of Justice – VHF High Band, conventional voice radio system with dedicated data network: A DOJ system operating independently of other agencies would not offer enough users to support a trunked environment. Due to small user counts, DOJ would not be eligible to license frequencies for a trunked radio system. Mission requirements could be addressed through continued use of conventional systems, but no improvements to interagency communications or interagency operating efficiencies would be realized.

Department of Parks and Recreation – 800 MHz and VHF High Band, conventional voice radio system with dedicated mobile data network: DPR has completed implementation of an 800 MHz, conventional voice radio system with VHF High Band providing coverage in selected areas of northern California. Operating independently of other agencies, DPR would maintain this configuration with incremental technological and coverage improvements as required. Mission requirements will be addressed through the continued use of this system configuration, but no improvements to interagency communications or interagency operating efficiencies will be realized.

Department of Transportation – 800 MHz, trunked voice radio system with dedicated data network: DOT has currently completed a significant portion of the implementation of this system. System expansion is limited due to the complete allocation of currently licensed 800 MHz channels. This configuration, however, will continue to provide DOT with the communications system it requires to successfully complete its mission, but no improvements to interagency communications or interagency operating efficiencies will be realized.

Department of Water Resources – VHF High Band, conventional voice radio system with dedicated data network: DWR's system is comprised of a small number of sites (relative to other agencies), with coverage generally limited to the California Aqueduct System. Existing coverage is adequate and channel congestion is low. Continued use of the conventional system will support agency communications needs, but no improvements to interagency communications or interagency operating efficiencies will be realized.

Department of the Youth Authority – 800 MHz and VHF High Band, trunked voice radio system with dedicated data network: CYA is installing 800 MHz radio systems at its institutions and will use this technology to equip its transport vehicles as well. The agency plans to maintain VHF High Band capability for its Parole division and also to support direct intercommunications between CDF and CYA's Institutions and Camps Branch. Coverage requirements specified by this system's configuration are limited to areas surrounding detention centers and the transportation routes connecting these and other criminal justice facilities. Mission requirements would be addressed by continued use of this system configuration, but no improvements to interagency communications or interagency operating efficiencies will be realized.

Office of Emergency Services – VHF High Band, conventional voice radio system with dedicated data network: OES' mission requires that it be capable of rapid communications with all public safety agencies. An OES system, operating independently of other agencies, does not provide the minimum required number of users to support a trunked environment, and therefore will be relegated to operation in a conventional mode. Currently, OES is able to communicate with other agencies through use of multiple radios, cross-band "patches", cellular telephone connection, and fixed satellite links. Continued use of conventional systems will support its mission, but no improvements to interagency communications or interagency operating efficiencies will be realized.

Cost Analysis

By implementing the system configurations described above, the State's public safety agencies will address those communications requirements not currently supported, but will realize no improvements to agency interoperability requirements or operating efficiencies. By pursuing independently operated systems, costs will be higher than any other approach. Below is a summary of the fifteen-year cost projections for fully implemented, independent agency system configuration initiatives considered for Alternative 2:

AGENCY	SYSTEM DESCRIPTION	ONE-TIME COSTS
CHP	Trunked, VHF High-Band and 746-869 MHz Voice; Dedicated Data	$1,148,349,000 to $1,655,487,000
CDC	Trunked & Conventional, VHF High-Band & 746-869 MHz Voice; Dedicated Data	267,329,000 to 375,442,000
DFG	Conventional, VHF High-Band Voice; Dedicated Data	200,998,000 to 306,270,000
CDF	Trunked & Conventional, VHF High-Band Voice; Satellite Data	360,108,000,000 to 527,261,000
DOJ	Conventional, VHF High-Band Voice; Dedicated Data	92,832,000 to 141,043,000
DPR	Conventional, VHF High-Band & 746-869 MHz Voice; Dedicated Data	335,585,000 to 493,901,000
DOT	Trunked, 746-869 MHz Voice; Dedicated Data	569,649,000 to 808,435,000

AGENCY	SYSTEM DESCRIPTION	ONE-TIME COSTS
DWR	Conventional, VHF High-Band Voice; Dedicated Data	37,061,000 to 59,614,000
CYA	Trunked & Conventional, VHF High-Band & 746-869 MHz Voice; Dedicated Data	235,809,000 to 351,723,000
OES	Conventional, VHF High-Band/UHF Voice; Satellite Data	73,044,000 to 111,798,000
	ONE-TIME TOTAL	***$1,931,856,000 to $2,809,877,000***
	15 YEAR RECURRING COSTS	***$1,297,645,000 to $1,498,762,000***
	15 YEAR TOTAL	***$3,251,649,735 to $4,341,260,119***

Appendix C provides further detail and the assumptions used for this cost analysis.

The advantage of this approach is that each agency's needs are met through extensive, but necessary, capital investments. Agency requirements for mobile data, improved coverage, and simplicity of operation are addressed by this approach. Autonomy of system management is maintained, but direct interoperability is lost. It also requires substantial site development to improve coverage. Lastly, the State cannot afford continued development of independent systems, and this alternative is the most costly solution.

F. ALTERNATIVE 3 – AGENCY SYSTEM SHARING

Alternative 3 presents a scenario in which unmet department needs are addressed by using shared radio systems. This approach assumes a single, statewide radio backbone, which is comprised of a hybrid of both VHF High-Band and UHF band infrastructure.

The foundation for this approach is based on the following set of assumptions:

1) State public safety departments are projected to operate communications systems as summarized in the table below:

AGENCY	SPECTRUM	VOICE TECHNOLOGY	DATA TECHNOLOGY	TYPICAL COVERAGE
CHP	VHF and UHF hybrid	Trunking	Dedicated network	Statewide, transportation routes, urban areas, access roads, etc.
CDC	746-869 MHz, VHF High Band (138-174 MHz)	Trunking	Dedicated network	Institutions & transportation routes
DFG	VHF High Band (138-174 MHz)	Conventional	Dedicated network	Statewide, transportation routes, recreational areas, etc.

AGENCY	SPECTRUM	VOICE TECHNOLOGY	DATA TECHNOLOGY	TYPICAL COVERAGE
CDF	VHF High Band (138-174 MHz)	Conventional & Trunking	Satellite	Primary response areas & ad-hoc coverage (wildlands, etc.)
DOJ	VHF High Band (138-174 MHz)	Conventional	Dedicated network	Statewide, mirrors CHP requirements
DPR	746-869 MHz, VHF High Band (138-174 MHz)	Conventional	Dedicated network	State parks and transportation routes
DOT	746-869 MHz and VHF Low Band	Trunking & Conventional	Dedicated network	State highways, access roads, and additional areas of responsibility
DWR	VHF High Band (138-174 MHz)	Conventional	Dedicated network	State aqueduct system
CYA	746-869 MHz, VHF High Band (138-174 MHz)	Conventional & Trunking	Dedicated network	Institutions & transportation routes
OES	VHF High Band, UHF	Conventional	Satellite	Statewide, wildlands (fire), flatlands (floods), faultlines (earthquakes), etc.

2) Any statewide "system" must support users in the two primary bands of spectrum indicated, i.e., VHF High-Band (138-174 MHz) and 746-869 MHz.

3) Statewide radio coverage can not be accomplished in the higher frequency band only as it would require too many sites to be cost effective.

4) A significant amount of VHF High-Band infrastructures already exists throughout the State (approximately 377 sites). By maintaining this VHF High-Band infrastructure throughout the State, and overlaying "800" MHz infrastructure throughout only the more urban areas of the State, effective interoperability is maintained and site requirements are kept to a minimum. Figure III-14 shows one potential configuration of a hybrid system where VHF High-Band only coverage is indicated by the darker shading, and 800 MHz (plus VHF) coverage is indicated by the lighter shading.

5) The number of sites required to support a statewide, shared system is assumed to be 1,025. If it would take 1,025 sites to provide the coverage required by the California Highway Patrol, the department with the most stringent coverage needs, it can be assumed that it would also take that many sites to provide coverage for all potential statewide radio system users.

6) As the Department with the most comprehensive coverage requirements (and with the equipment that is most closely nearing obsolescence), the new hybrid system would be designed and implemented to support CHP radio users first.

7) Other departments would migrate their operations onto the statewide, trunked, hybrid backbone as it becomes cost effective for them to do so. This would take place when a Department's user equipment requires scheduled replacement. In some instances, a particular Department may not realize full life expectancy from its fixed equipment, as it will have to replace this equipment when it replaces its user equipment. This, however, is a necessary function of the fact that user equipment tends to last only five to seven years, whereas fixed equipment may last upwards of 12 to 15 years.

ECONOMIC ANALYSIS

The one-time costs associated with this alternative will range from $1.526 billion to $2.152 billion. Recurring costs over a 15-year period will range between $1.215 billion and $1.393 billion; thus, the fifteen-year cost of this alternative could range between $2.741 billion and $3.545 billion.

SYSTEM DESCRIPTION	ONE TIME COSTS
Statewide, shared voice and data systems	$1,526,290,350 to $2,152,811,460
ONE-TIME TOTAL	***$1,526,290,350 to $2,152,811,460***
15 YEAR RECURRING COSTS	***$1,215,377,500 to $1,392,844,000***
15 YEAR TOTAL	***$2,741,667,850 to $3,545,655,460***

Appendix D provides a detailed cost analysis and assumptions of the required elements for this alternative.

ADVANTAGES

- ***Improved interoperability*** – By using shared infrastructures, it will be much easier to facilitate communications between departments. Rather than being forced to find mutual channels or contacting a dispatcher to provide a patch, users will be able to simply "dial" in a mutual aid partner's talk-group and commence communications.

- ***Increased access to expensive technologies*** – Departments will be in a better position to implement the latest technological improvements and system development costs will be borne by 10 organizations, not just one.

- ***Reduced staffing requirements for maintenance*** – With newer technology, there will be less system down time, and potentially less requirements for actual maintenance staff. Also, advanced technologies provide the capability of remote diagnostics, which allow fewer maintainers to properly service such complex technologies.

- ***Reduction in redundant infrastructure*** – Cost savings are realized as the vision of shared systems is implemented and redundancy is decreased. Rather than implementing communications infrastructures throughout the State, which could require well over 2,500 sites to support, the same coverage can be provided for all users with only 1,025 sites.

DISADVANTAGES

- ***Significant capital expenditures required*** – To initiate this alternative, significant capital is required. Upwards of $1 billion will be required for backbone costs alone. There is a benefit though in that once this capital investment has been absorbed, the costs to the user Departments will only be incurred when it is necessary to migrate their user equipment onto the new backbone.

- ***Detailed, focused planning efforts required*** – This alternative requires years of effort and a strongly focused vision of the future benefits gained by the implementation of shared systems. It will be a significant challenge to ensure that a solid structure for system governance is established before hardware is procured and installed and operations are migrated onto the new infrastructure.

- ***Heavy reliance on the acquisition of "new" spectrum*** – To make a shared system approach viable, it will be necessary for the State to acquire a significant amount of spectrum in the UHF band (as well as additional channels in the VHF band). This must be accomplished before any system implementation occurs.

ANALYSIS OF ALTERNATIVES

EXHIBITS

THE WARNER GROUP

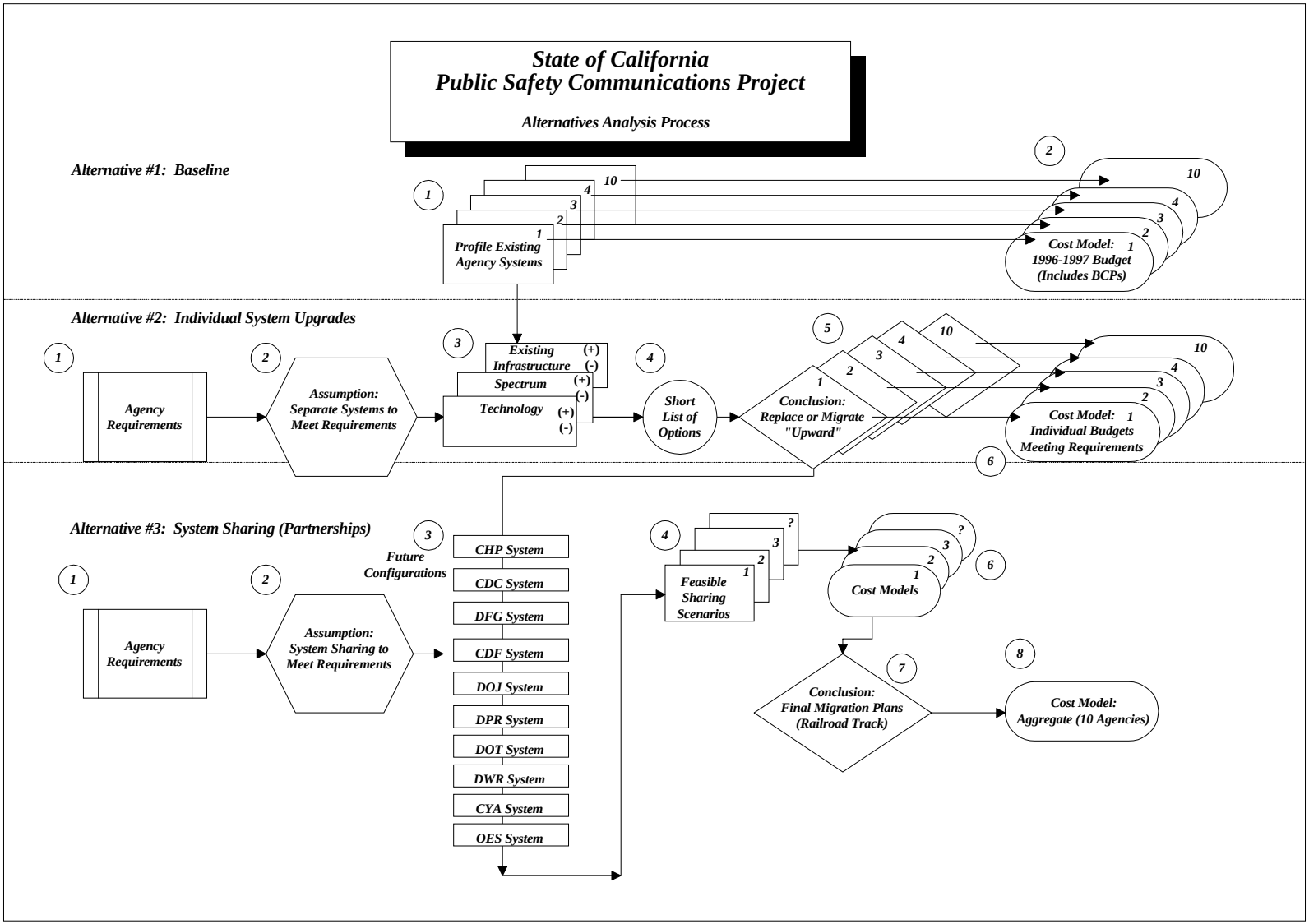
STATE OF CALIFORNIA
Public Safety Radio Communications Project

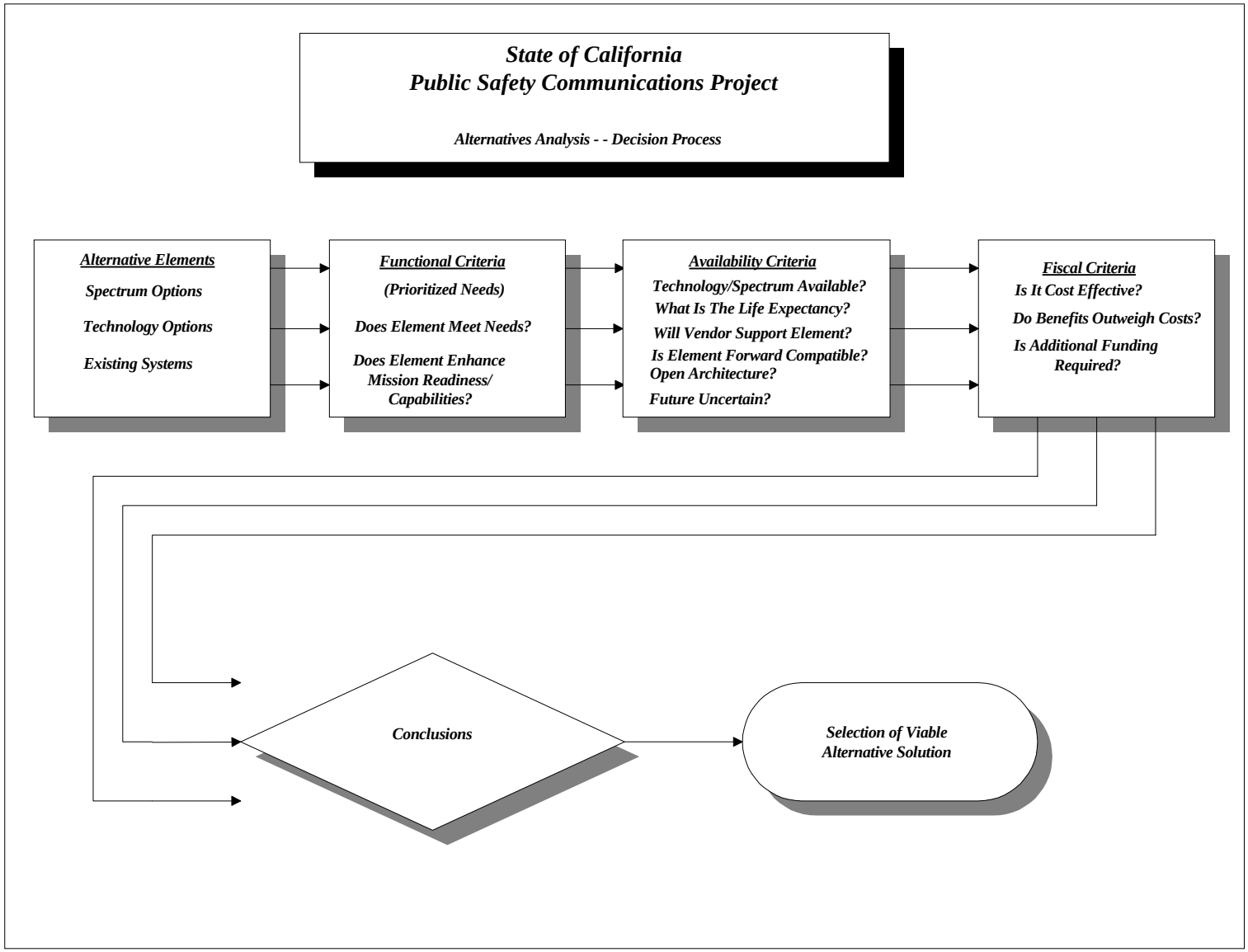
Summary of Prioritized System Requirements by Agency/Department

		CHP	CDC			DFG	CDF	DOJ	DPR	DOT	DWR	CYA			OES
			Inst	Parole	Trans							Inst	Parole	Trans	
Select Feature Requirements															
1.1.1	Call/unit prioritization	A	A	B	A	B	A	A	A	D	B	A	B	A	A
1.1.2	Emergency alerting	A	A	A	A	B	A	A	B	D	B	A	A	A	B
1.1.3	CAD unit display	A	D	D	D	C	A	D	A	C	n/a	D	D	D	D
1.1.4	Out of range indication	B	B	B	B	B	B	A	B	A	B	B	D	B	B
1.1.5	Talk around (direct unit-to-unit)	A	A	A	A	A	A	A	A	D	A	A	A	A	A
1.1.6	Individually addressable units	C	D	D	D	D	C	C	B	A	A	D	D	D	D
1.1.7	Private unit-to-unit conversations	D	D	C	C	C	C	B	B	D	A	C	B	C	C
1.1.8	Multi group call	A	A	C	B	B	A	A	A	D	A	A	D	A	A
1.1.9	Unit identification	A	A	D	A	C	B	A	C	A	A	A	D	A	D
1.1.10	Telephone interconnect	D	D	D	B	D	D	D	D	D	B	D	D	B	B
1.1.11	Dispatching (point to multipoint)	A	A	A	A	A	A	A	A	A	A	A	A	A	A
1.2.1	Encryption	B	B	B	B	B	B	A	D	D	D	B	B	B	D
1.2.2	Unit disable	B	B	B	B	D	B	B	B	B	B	B	B	B	B
2.1.1	Roaming	A	B	A	A	A	C	A	A	A	A	C	B	A	C
2.1.2	Critical buildings	A	A	A	A	A	A	A	A	A	A	A	A	A	A
2.2.1	Portable coverage	A	A	A	A	A	A	A	A	A	A	A	A	A	A
2.3.1	Mobile coverage	A	A	A	A	A	A	A	A	A	A	A	A	A	A
3.1.1	Narrowbanding	A	A	A	A	A	A	A	A	A	A	A	A	A	A
3.1.2	Flexible channelization	A	B	B	B	B	B	A	D	D	D	B	B	B	B
3.1.3	Dynamic regrouping	B	B	B	B	D	B	B	D	D	C	B	D	B	B
3.2.1	Immediate channel access	A	A	A	A	A	A	A	A	D	B	A	A	A	B
3.2.2	Grade of service	A	A	A	A	A	A	A	A	A	A	A	A	A	A
3.3.1	System growth	A	A	A	A	A	A	A	A	A	A	A	A	A	A
5.2.1	Expansion	A	A	A	A	A	A	A	A	A	A	A	A	A	A
6.1.1	Shared systems	A	A	A	A	A	A	A	A	A	A	A	A	A	A
6.2.1	Standard equipment	A	A	A	A	A	A	A	A	A	A	A	A	A	A
6.3.1	Management reporting	C	C	C	C	D	C	C	C	A	D	C	D	C	C
Interoperability Requirements															
4.1.1	Multi-agency (state)	A	A	A	A	A	B	A	A	B	B	A	A	A	B
4.1.2	Multi-agency (local)	A	A	A	A	A	A	A	A	A	B	A	A	A	A
4.1.3	Multi-agency (federal)	B	D	B	B	A	A	C	A	D	B	B	D	D	D
4.2.1	Reduce complexity	A	A	A	A	A	A	A	A	A	A	A	A	A	A
4.3.1	Reduce spare parts inventories	A	A	A	A	A	A	A	A	A	A	A	A	A	A
5.1.1	Multi-agency systems	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Mobile Data Requirements															
7.1.1	Computer Aided Dispatch (CAD)	A	n/a	D	A	C	A	n/a	A	C	n/a	n/a	n/a	n/a	n/a
7.1.2	Database info. (CLETS, DMV)	A	n/a	A	D	A	A	A	A	B	n/a	A	A	A	B
7.1.3	Agency specific applications	C (1)	n/a	A (2)	D (3)	D	C (4)	n/a	C (5)	C (6)	n/a	A (7)	A (7)	A (7)	C(3)/A(7)
7.1.4	Records Management System (RMS)	C	n/a	n/a	n/a	D	C	D	A	D	n/a	n/a	n/a	na	C
7.2.1	Automatic Vehicle Location (AVL)	C	n/a	D	A	A	D	D	B	C	C	B	B	A	A/B
7.2.2	Premise warnings	A	n/a	D	n/a	D	A	B	B	n/a	n/a	B	B	B	B
7.2.3	Hazardous materials information	B	n/a	n/a	n/a	D	A	D	B	A	D	B	D	D	B
7.2.4	Images	B	n/a	A	D	D	B	B	A	D	B	B	B	B	B
7.3.1	Electronic messaging	A	n/a	A	B	D	A	A	A	C	B	B	B	B	B
7.4.1	Response time	A	n/a	A	A	A	A	A	A	A	n/a	A	A	A	A
7.4.2	CAD response	A	n/a	A	A	A	A	n/a	A	A	n/a	n/a	n/a	n/a	n/a

(1) A44 Locator System
(2) CPIN, CMIS, OBIS
(3) Miscellaneous reports, business functions (e.g., time sheets, travel claims)
(4) Automatic Aircraft Location used for management tracking purposes
(5) Booking reports
(6) Service reports, work orders
(7) Specialized database information

Key
A = Critical, routinely used
B = Critical, non-routinely used
C = Non-critical, routinely used
D = Non-critical, non-routinely used


State of California
Public Safety Communications Project
Alternatives Analysis Process
Alternative #1: Baseline
1
Profile Existing Agency Systems
2
Cost Model: 1996-1997 Budget (Includes BCPs)
Alternative #2: Individual System Upgrades
1
Agency Requirements
2
Assumption: Separate Systems to Meet Requirements
3
Existing Infrastructure (+) (-)
Spectrum (+) (-)
Technology (+) (-)
4
Short List of Options
5
Conclusion: Replace or Migrate "Upward"
Cost Model: Individual Budgets Meeting Requirements
6
Alternative #3: System Sharing (Partnerships)
1
Agency Requirements
2
Assumption: System Sharing to Meet Requirements
3
Future Configurations
CHP System
CDC System
DFG System
CDF System
DOJ System
DPR System
DOT System
DWR System
CYA System
OES System
4
Feasible Sharing Scenarios
6
Cost Models
7
Conclusion: Final Migration Plans (Railroad Track)
8
Cost Model: Aggregate (10 Agencies)


State of California
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Alternatives Analysis - - Decision Process
Alternative Elements
Spectrum Options
Technology Options
Existing Systems
Functional Criteria
(Prioritized Needs)
Does Element Meet Needs?
Does Element Enhance Mission Readiness/ Capabilities?
Availability Criteria
Technology/Spectrum Available?
What Is The Life Expectancy?
Will Vendor Support Element?
Is Element Forward Compatible? Open Architecture?
Future Uncertain?
Fiscal Criteria
Is It Cost Effective?
Do Benefits Outweigh Costs?
Is Additional Funding Required?
Conclusions
Selection of Viable Alternative Solution

Technical and Spectrum Options

Voice	Data	Spectrum
• Conventional radio • Trunked radio • Analog signal • Digital signal • Single Side-band (SSB) • Low Earth Orbit (LEO) satellite • Geo-stationary Earth Orbit (GEO) satellite • Channel access technologies - Frequency division multiple access (FDMA) - Time division multiple access (TDMA) - Code division multiple access (CDMA) • Cellular telephone system • Specialized Mobile Radio (SMR) vendor	• Dedicated mobile data network • Integrated voice and data network • Circuit Switched Cellular (CSC) • Cellular Digital Packet Data (CDPD) • Private Packet Radio Network (PPRN) • Enhanced Specialized Mobile Data Radio (ESMR) • Personal Communications System (PCS) • Enhanced paging • Satellite Mobile Data (SMD) • Automatic vehicle location (AVL)	• VHF Low-Band: 25-50 MHz • VHF High-Band: 150-174 MHz • 220 MHz Band: 220-222 MHz • UHF Band: 450-470 MHz • UHF-T Band: 470-512 MHz • UHF Channels 60-69: 746-806 MHz • 800 MHz Band: 806/821-824/ 866-869 MHz

Exhibit III-5(a)

STATE OF CALIFORNIA
PUBLIC SAFETY RADIO COMMUNICATIONS PROJECT

Alternative 3 – Voice Technical Option Analysis Summary

Agency	*Conven. Radio*	*Trunked Radio*	*Signal-Analog*	*Signal-Digital*	*SSB*	*Satellite-LEO*	*Satellite-GEO*	*FDMA*	*TDMA*	*CDMA*	*CTSU*	*SMR*
CHP	-	+	+	+	-	-	-	+	+	+	-	-
CDC(Inst)	-	+	+	+	-	-	-	+	+	+	-	-
CDC(Par)	-	+	+	+	-	-	-	+	+	+	-	-
CDC(Tran)	-	+	+	+	-	-	-	+	+	+	-	-
DFG	+	+	+	+	-	-	-	+	+	+	-	-
CDF	-	+	+	+	-	+	-	+	+	+	+	-
DOJ	+	+	+	+	-	-	-	+	+	+	-	-
DPR	-	+	+	+	-	-	-	+	+	+	-	-
DOT	-	+	+	+	-	-	-	+	+	+	-	-
DWR	+	+	+	+	-	-	-	+	+	+	-	-
CYA(Inst)	-	+	+	+	-	-	-	+	+	+	-	-
CYA(Par)	-	+	+	+	-	-	-	+	+	+	-	-
CYA(Tran)	-	+	+	+	-	-	-	+	+	+	-	-
OES	-	+	+	+	-	-	-	+	+	+	-	-

Note:

CDMA- Code Division Multiple Access
CTSU- Cellular Telephone System Use
FDMA- Frequency Division Multiple Access
GEO- Geostationary Earth Orbit Satellite
LEO- Low Earth Orbit Satellite
SMR- Specialized Mobile Radio (Vendor)
SSB- Single-Sideband Radio
TDMA- Time Division Multiple Access

+ = Meets Need
- = Does Not Meet Need

Exhibit III-5(b)

STATE OF CALIFORNIA
PUBLIC SAFETY RADIO COMMUNICATIONS PROJECT

Alternative 3 – Data Technical Option Analysis Summary

Agency	*DMDN*	*IV & DN*	*CSC*	*CDPD*	*PPRN*	*ESMR*	*PCS*	*SMD*	*E-Paging*	*MSTs*	*MDTs*	*MDCs*	*PDDs*	*AVL*
CHP	+	+	-	+	-	-	-	+	-	-	-	+	-	+
CDC(Inst)	*N/A*													
CDC(Par)	+	+	-	+	-	-	-	+	-	-	-	+	-	+
CDC(Tran)	+	+	-	+	-	-	-	+	-	-	-	+	-	+
DFG	+	+	-	+	-	-	-	+	-	-	+	+	-	+
CDF	+	+	-	+	-	-	-	+	-	-	-	+	-	+
DOJ	+	+	-	+	-	-	-	+	-	-	-	+	-	+
DPR	+	+	-	+	-	-	-	+	-	-	-	+	-	+
DOT	+	+	-	+	-	-	-	+	-	-	-	+	-	+
DWR	+	+	-	+	-	-	-	+	-	-	-	+	-	+
CYA(Inst)	+	+	-	+	-	-	-	-	-	-	-	+	-	+
CYA(Par)	+	+	-	+	-	-	-	+	-	-	-	+	-	+
CYA(Tran)	+	+	-	+	-	-	-	+	-	-	-	+	-	+
OES	+	+	-	+	-	-	-	+	-	-	-	+	-	+

Note:

AVL- Automatic Vehicle Location
CDPD- Cellular Digital Packet Data
CSC- Circuit Switched Cellular
CTSU- Cellular Telephone System Use
DMDN- Dedicated Mobile Data Network
E-Paging- Enhanced Paging
ESMR- Enhanced Specialized Mobile Radio
IV & DN- Integrated Voice and Data Network
MDC- Mobile Data Computer
MDT- Mobile Data Terminal
MST- Mobile Status Terminal
PCS- Personal Communication System
PDD- Portable Data Devices
PPRN- Private Packet Radio Networks (RAM, ARDIS)
SMD- Satellite Mobile Data

+ = Meets Need
- = Does Not Meet Need

Exhibit III-5(c)

STATE OF CALIFORNIA
PUBLIC SAFETY RADIO COMMUNICATIONS PROJECT

Alternative 3 – Spectrum Option Analysis Summary

Agency	*VHF Low-Band 25-50 MHz*	*VHF High-Band 150-174 MHz*	*220 MHz Band 220-222 MHz*	*UHF Band 450-470 MHz*	*UHF-T Band 470-512 MHz*	*UHF Channels 60-69 746-806 MHz*	*800 MHz Band 806/821-824/866-869 MHz*
CHP	-	-	-	-	+	+	-
CDC(Inst)	-	-	-	-	-	+	-
CDC(Par)	-	+	-	-	-	+	-
CDC(Tran)	-	-	-	-	-	+	-
DFG	-	+	-	-	-	-	-
CDF	-	+	-	-	-	-	-
DOJ	-	-	-	-	-	+	-
DPR	-	-	-	-	-	+	-
DOT	-	-	-	-	-	+	-
DWR	-	+	-	-	-	+	-
CYA(Inst)	-	-	-	-	-	+	-
CYA(Par)	-	+	-	-	-	+	-
CYA(Tran)	-	-	-	-	-	+	-
OES	-	+	-	+	-	+	-

Note:
+ = Meets Need
- = Does Not Meet Need

Exhibit III-6

Conventional Radio vs. Trunked Radio

	Advantages	Disadvantages
Conventional Radio	• Proven, reliable technology • Simple technology • Lower cost • Pervasive • Non proprietary • Supported by a large number of vendors	• Less efficient use of frequencies • Higher potential for interface • Complexity of roaming
Trunked Radio	• Proven technology • Efficient use of frequencies • System redundancy/fault tolerance • Talkgroups/channelization • State-of-the-art features • Adoption by larger agencies and regional systems	• Higher cost • Technical complexity • New equipment required • Potentially proprietary system • More technically sophisticated maintenance required • Minimum requirement of approximately 100 users per channel

Exhibit III-7

Analog Signal vs. Digital Signal

	Advantages	Disadvantages
Analog Signal	• Proven, reliable technology • Simple technology • Lower component cost • Familiar operating characteristics • Supported by a large number of vendors	• Reduced audio quality as range from fixed site increases • Older technology; less vendor emphasis on development
Digital Signal	• Spectrum efficiency • Enhanced audio quality up to fringe areas • Improved privacy • Ability to support both voice and data transmissions • Reduction of “noise” and interference	• Higher cost • Technical complexity, more complex maintenance • Smaller vendor base • Less familiar operating characteristics • Potentially more sites

Exhibit III-8

Single Side-Band Radio

Advantages	Disadvantages
• Relative spectrum efficiency	• Requires equipment replacement • Unfavorable portable unit power characteristics reported by users • Increased noise and interference • Very limited availability and use

Exhibit III-9

Channel Access Technologies

	Advantages	Disadvantages
Frequency Division Multiple Access (FDMA)	• Backward compatibility • Talk-around capability • Higher power portable radio • Conformity with APCO 25 • Potential multiple sources	• Limited ability to improve spectrum efficiency • Data transmissions may require separate wide-band channels
Time Division Multiple Access (TDMA)	• Potentially higher degree of spectrum efficiency • Ability to support higher data rates • Conformity with APCO 25 Phase II	• Requirement for full bandwidth channel to support talk-around • Potentially proprietary technology • Power consumption
Code Division Multiple Access (CDMA)	• Potentially higher degree of spectrum efficiency • Ability to support high data rates • Low power portable radios • Provision of real time down-link signaling capability • Dual mode/band equipment • Inherent security	• Requirement for full bandwidth channel to support talk-around • Not currently available in Public Safety systems • Centralized synchronization and control

Exhibit III-10

Satellite Technology

	Advantages	Disadvantages
Geo-stationary Earth Orbit (GEO) Satellite	• Wide area coverage • Reduced interference • Reduced initial investment • Available now • Accessibility from remote areas • Access to PSTN • Ability to support voice and data	• Significant propagation delay • Reduced urban coverage (line of site) • No portable devices • Single point of failure • Low data rates • Limited talk-groups • Recurring costs
Low Earth Orbit (LEO) Satellite	• Extensive coverage • Little propagation delay • Reduced interference • Reduced initial investment • Access to PSTN • Ability to support voice and data	• Entire system must be in place before operable • Limited availability • Undefined features and capabilities • Recurring costs • No planned dispatching services

Exhibit III-11

Cellular Telephone Systems

Advantages	Disadvantages
• Inexpensive user devices • No fixed equipment investment required • Transparent roaming • Easy access to Public Switched Telephone Network (PSTN) • User friendly • Meets specialized application needs	• Supports only point-to-point conversations • Lack of coverage in low population density areas • Limited priority access capability • Potentially high recurring costs • Limited control over fixed equipment • Potential to lose signal on cell hand-off • Blocked access during regional disasters • Cumbersome to use in emergency situations

Exhibit III-12

Specialized Mobile Radio

Advantages	Disadvantages
• Absence of fixed equipment investment • Transparent roaming • Easy access to Public Switched Telephone Network (PSTN) • Integrated broadcast, telephone and paging services	• Lack of coverage in low population density areas • Limited priority access capability • Potentially high recurring costs • Limited control over fixed equipment • Limited competition among service providers • Lack of public safety grade equipment

• User friendly	

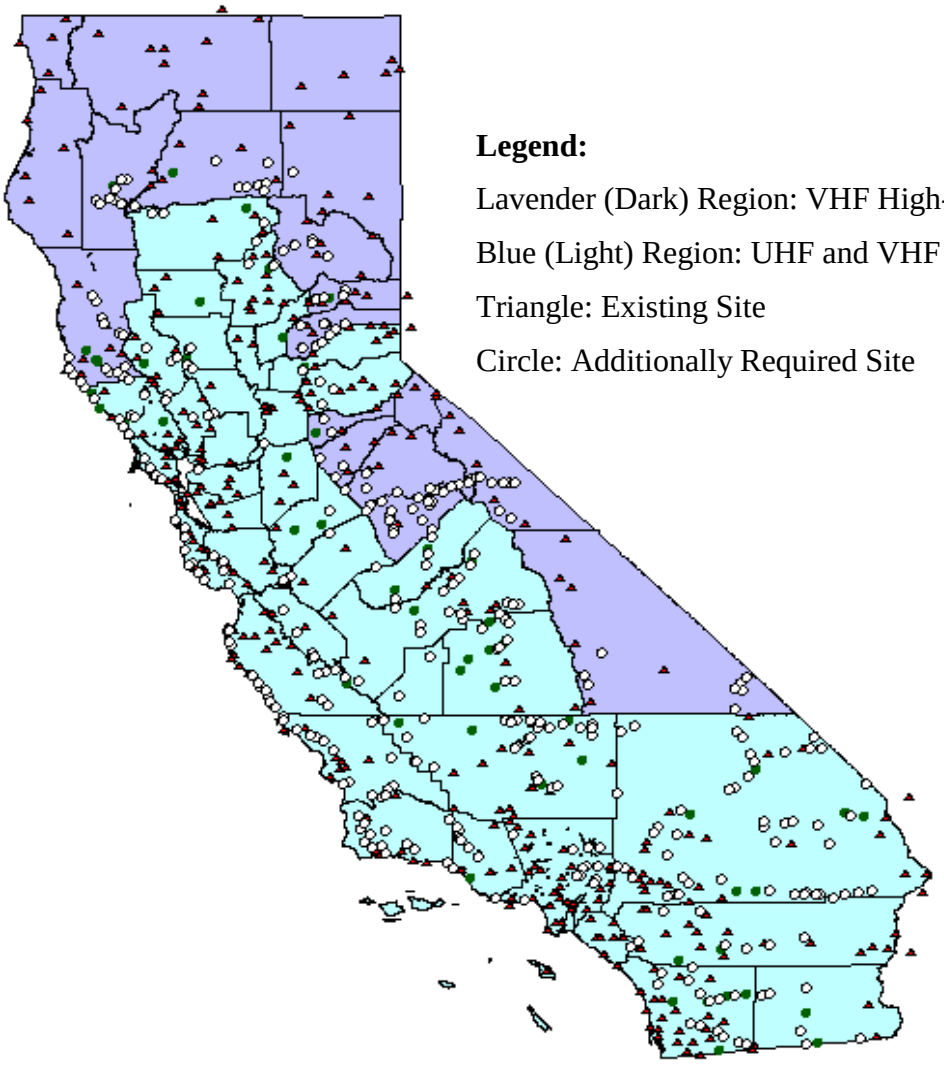
Exhibit III-13

Mobile Data Transport

Technology	Characteristics	Data Speeds
Dedicated Mobile Data Network/Private Packet Radio	• System dedicated to system owner use only • Overlapping coverage with voice radio system • Suited for many users • Good performance for public safety applications • Proprietary protocols	4,800 – 19,200 baud
Integrated Voice and Data Network/ESMR	• Integrated voice and data transmissions • Common radio equipment • Limited coverage area	4,800 – 9,600 baud
Circuit Switched Cellular	• Uses existing cellular telephone network • Session-based transmission (dial-up) • Shared general use	14,400 baud
Cellular Digital Packet Data (CDPD)	• Upgraded cellular telephone network • Limited coverage area • Shared general use • IP addressing	19,200 baud
Personal Communications Systems (PCS)	• Being implemented/limited coverage area • Suited for highest volume data requirements	30,000 baud (TBD)
Satellite Mobile Data	• Circuit switched and packet approaches • "Visual" coverage area	120 – 9,600 baud
Enhanced Paging	• Two-way messaging • Limited coverage area • Low cost equipment • Responses limited to predefined messages	1,200 – 2,400 baud

Exhibit III-14

Hybrid Backbone Configuration



Legend:

Lavender (Dark) Region: VHF High-Band Only

Blue (Light) Region: UHF and VHF High-Band

Triangle: Existing Site

Circle: Additionally Required Site

SECTION IV

MANAGEMENT PLAN

THE WARNER GROUP

A. INTRODUCTION

Completion of the Strategic Plan identified that "*..the lack of effective and reliable radio communications impedes California's public safety departments' ability to perform their basic mission: the protection of life and property*." It also addressed the need for universal, statewide access to the radio system, improved interoperability, enhanced functionality and channel availability, as well as a vision of system-sharing.

The completion of the first three sections of this document finalized California's detailed requirements, explored alternatives, and determined the feasible direction for California to follow. This final section of the document provides the following:

- ***Project Structure –*** Provides an overview of the management hierarchy associated with the project.
- ***Project Plan –*** Reflects the methodology that will guide the implementation effort.
- ***Risk Management Plan –*** Describes the approach that will be used continuously to assess and mitigate risk factors that could interfere with the successful completion of the project.

B. MANAGEMENT HIERARCHY

The magnitude and complexity of this project cannot be overemphasized. The 10 departments participating in the project have, therefore, spent considerable effort to ensure that the management hierarchy will provide an organizational structure that will enable a process by which a continuous method of checks and balances can be accomplished throughout the life of the project. The Management Hierarchy will consist of the following:

- ***Department of General Services (DGS) –*** DGS has legislative authority to manage telecommunications projects and to provide support services to all departments. As such, the Director of DGS has delegated the management of the State's public safety radio project to a Project Manager who will report to the this same DGS director.

- ***Steering Committee –*** The Steering Committee is comprised of representatives from the 10 participating departments. These individuals, appointed by their department directors, represent the unique needs of their individual departments and provide a forum for ongoing collaboration and interagency partnering.

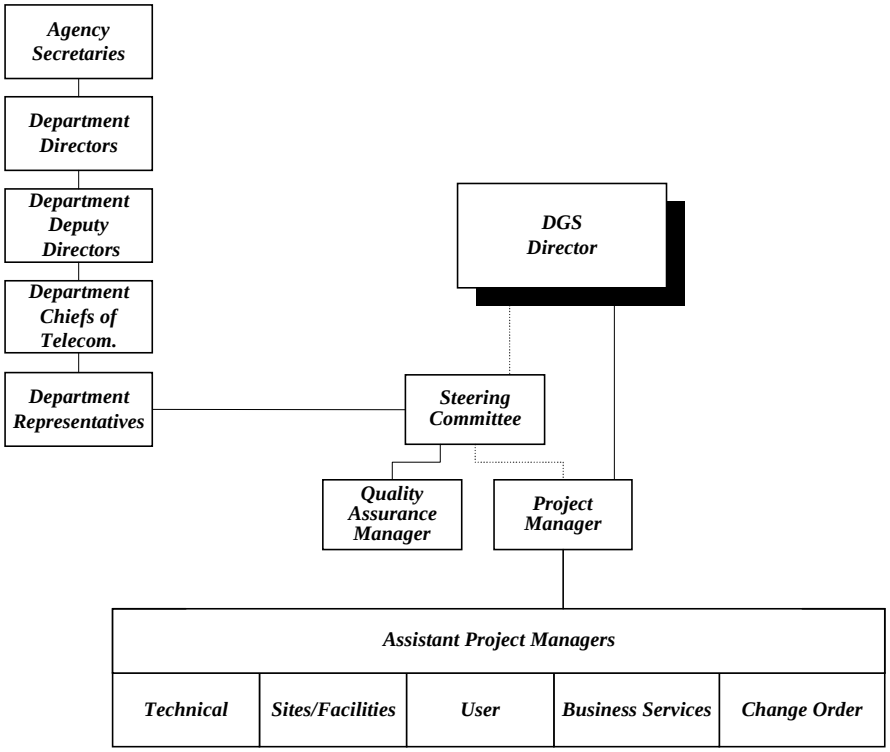
- ***Project Manager –*** The Project Manager is the single point of contact for all issues associated with the project. He/she is responsible for maintaining project schedules, adhering to project scope, and ensuring adequate resources are made available for a successful project completion.

- ***Assistant Project Managers –*** Given the magnitude of the project and the number of entities that will play significant roles, the Project Manager will be assigned multiple Assistant Project Managers to direct specific portions of the project. These Assistant Project Managers will have responsibility for the areas of technical services, sites/facilities development, user groups support, business services functions, and change management.

- ***Quality Assurance Manager –*** Based on the costs and complexity of the project and the need for continuous checks and balances, a neutral party will be tasked with providing continuous auditing and oversight for all facets in the completion of the project. This individual will report to the Steering Committee.

Project Organizational Structure

The organizational structure outlined below provides the direct accountability for the project:



Project Roles & Responsibilities

Using the hierarchy described above, the roles and responsibilities of each entity are as follows:

- ***Department of General Services (DGS) –*** It is the responsibility of DGS to provide the vast majority of the project technical support services necessary to meet the public safety radio communications operational requirements of the 10 participating departments. Based on input from the Steering Committee, DGS will obtain the services of a Project Manager, Assistant Project Managers, and a Quality Assurance Manager to oversee the project completion. DGS shall empower the Project Manager with the authority to coordinate resources to meet the direction of the Steering Committee. DGS will also provide required technical assistance and facilitation to the Steering Committee as requested.

- ***10 Participating Departments –*** The 10 departments participating in the project have the responsibility for providing public safety services. They need communications to carry out this mission. The director of each department will assign a member to the Steering Committee to represent the unique public safety radio communications needs of their individual departments and to provide a forum for ongoing planning, collaboration, interdepartmental partnering, and resource allocation. The individuals assigned will have the responsibility to keep their departments advised of the project status.

- ***Steering Committee –*** The Steering Committee will continue to provide a forum for ongoing collaboration and interdepartmental coordination. It will act as the governing body for the public safety radio communications project. Specifically, its responsibilities are as follows:

  - ***Overall Project Management –*** As the project's governing body, oversight for completion of the project resides with this committee. The Steering Committee will participate in the recruitment, selection and direction of the activities of the Project Manager and the Quality Assurance Manager. The Steering Committee will provide ongoing input to the project manger.

  - ***Short & Long Range Planning –*** As representatives of the 10 departments, the Steering Committee is responsible for ensuring individual department's operational needs are continuously evaluated and incorporated into the planning efforts required for completion of this project.

  - ***Quality Assurance –*** The Steering Committee is responsible for providing continuous direction to the independent entity hired.

- ***Project Manager –*** The Project Manager is responsible for all project management activities relative to the acquisition and implementation of the voice

and data users' systems as well as the carrier systems. These responsibilities include the following:

- Spectrum Acquisition
- Legal/Regulatory Compliance
- Fiscal/Contract Management/Procurement
- Site Acquisition & Facilities Development Magnet
- Technical Requirements Management
- Systems Design Management
- Change Order Management
- Transition/Cut Over Management
- Configuration Management
- Materials Storage & Logistics Management
- Agency Training

The Project Manager will control the day to day activities of the assistant project managers and provide routine and/or special status report to the Steering Committee and the Director of the Department of General Services.

- ***Assistant Project Managers –*** Due to the magnitude and complexity of the project, Assistant Project Managers will be assigned to serve as extensions for the project manager. They will work closely with the project manager and the various project support functions to ensure continued development and implementation of the project.

- ***Quality Assurance Manager –*** The Quality Assurance Manger will initiate an ongoing audit process to ensure quality standards for all aspects of the project are met. This will include audit processes in the following areas:

  - Budget Tracking
  - Technical Standards Compliance
  - Resource Utilization
  - Legal/Regulatory Compliance

  The Quality Assurance Manager will provide routine and/or special status reports to the Steering Committee and the Director of the Department of General Services.

C. PROJECT PLAN

Years of research and collaboration among the departments have clearly identified the need for California's public safety radio users to share resources whenever and wherever possible. The recent failure of high visibility technology projects have made it clear that to design and

implement a project of this magnitude requires not only a well-planned and coordinated effort, but also requires proof of practice.

The following provides an overview of the key activities and steps required for successful completion of the project. The initial steps, the development of both the Strategic Plan and the Cost Benefit Analysis have been completed. Ensuing project activities will provide the foundation for reduced fiscal risk and enhanced project success.

Key Activities

- ***Overall Project Management –*** This activity is required to maintain established schedules and budgets, and to provide a mechanism by which corrections can be made to keep the project on track as deviations occur.

- ***Contract Management –*** The State must continually monitor the contracts initiated to support system design, installation, testing, etc. As the project evolves, the likelihood of changes in contractual deliverables become greater. It becomes more critical to monitor the proper execution of contract terms to ensure the initial intent of the contract is met in a timely manner.

- ***Change Order Control/Management –*** As technology develops, portions of the project become more susceptible to obsolescence. It is important to ensure that changes are made to system features only when they are necessary. It will be incumbent on the State to monitor advancements in technology and to ensure that the appropriate system design and development occurs. In addition, contracts will be written to maximize state-of-the-art equipment with mandatory project lifecycle compatibility. The project manager will be responsible for monitoring these advancements and coordinating the necessary changes.

- ***System Administration –*** The daily operation of the system requires the on-going process of updating and maintaining user databases, unit IDs, etc. The administrative effort is required from the initial implementation of new user equipment throughout the lifecycle of the system.

- ***Radio Network Management –*** Ensures that proper connectivity is maintained, that system software is kept current, and that system use appears seamless to all system users. This is an effort that begins at initial system implementation, and continues throughout the lifecycle of the system.

- ***Configuration Management –*** Ensures compatibility with system hardware and software throughout the lifecycle of the system. This is critical due to the lengthy implementation time frame required for this project.

- ***Fiscal Management –*** Ensures that funds are available to advance the project and that there is an accounting for current expenditures.

- ***Quality Assurance –*** Ensures the State is receiving quality work products from all entities involved in the implementation process and ensures adherence to established methodologies, control procedures, etc.

- ***Legal/Regulatory Compliance –*** The current regulatory environment, as it relates to use of wireless radio, is in a constant state of flux. Therefore, continued support is required throughout the entire implementation cycle, as it may become necessary to revise a particular technical approach to accommodate new standards or simply to be in compliance with new legislation or regulations.

Key Steps

The information provided below identifies the major steps or tasks required to design and implement a project of this magnitude. While many of these tasks will run concurrently, a vast number of the tasks will be dependent upon one another for completion.

- ***Acquisition of Required Spectrum –*** A critical step in this project is the acquisition of the spectrum that is required for development of the new infrastructure. The State is currently working with the Federal Communication Commission (FCC) to identify and acquire this spectrum.

- ***Pilot Projects –*** To demonstrate the benefits of consolidation and to refine the proposed model, it will be necessary to implement pilot projects. Appropriate geographical locations will be identified to validate that the proposed alternative will overcome the challenges of technology and interoperability while still meeting Department unique operational requirements. During this time period smaller pilots meeting established criteria may be implemented to test the success of partnering and sharing. Once proof of concept is validated the statewide implementation will begin.

- ***Refine User Requirements –*** Based upon results of the pilot project and the identification of available spectrum, user requirements will be refined. This process will enable system designers to propose solutions specifically designed to address the needs of the State's Departments.

- ***Determine System Design & Implementation Criteria –*** Representatives from each participating department will provide input to project engineers for detailed system configurations. These detailed configurations will provide the blueprint for the proposed system. The State must consider the advantages/ disadvantages of using internal resources and/or soliciting bids from vendors to design and build the system. If the decision is made to solicit bids, then a draft Request for Proposals (RFP) would be issued, a short list of qualified vendors would be developed, and then a final RFP, complete with detailed design specifications would be issued.

- ***Procurement Process –*** The procurement of the services and necessary equipment will be a massive undertaking, spread over many years, during which the backward and forward compatibility of equipment and services must be maintained. During this process, the State would develop and negotiate the required procurement contract(s) necessary to support systems acquisition.

- ***Site Acquisition and Facilities Development –*** The acquisition and development of required sites is a critical path item. This includes acquisition of new sites, modification of existing sites, initiation of leases, vault design and build out, and tower design and construction. This is a lengthy process, one complicated by California's geographical size, changing terrain, weather conditions, varying population densities, numerous environmental agencies, radio signal propagation characteristics and local and county regulatory entities.

- ***Installation of New System –*** At this stage of the project, facilities and sites are ready to accept new/upgraded equipment and end user equipment is acquired, programmed and installed. New system installation will reflect the phasing concept described in Section II, Proposed Alternative.

- ***Acceptance Testing –*** Upon completion of installation, the new system will be tested to prove their integrity and functionality. The State, through the procurement process, will define the terms and conditions of a successful acceptance test. The participating departments will not "take ownership" until acceptance testing indicates a fully operational installation.

- ***Transition/Cut-over Process –*** Once it is proven that the system is functioning properly, the participating departments will begin the process of migrating onto the new/upgraded system. This process will require considerable coordination, since some departments will remain on existing system for a longer period of time. Refer to the Proposed Alternative, on page 9 of Section II of this document.

- ***Employee System Training –*** As departments cut over to new systems, it is projected that over 50,000 employees will be trained on the use of this new equipment which will provide services and functions not currently available under existing systems. A lack of training will jeopardize the ability of public safety personnel to use the equipment to its full potential. The State will require manuals, operating procedures, and other documentation from vendors and service suppliers to ensure users are properly educated on system functionality. Training will cover both end user and technical/maintenance personnel.

- ***New System Evaluation and Modifications –*** Agencies will evaluate performance and implement modifications, if required. The Project Manager and his/her staff will coordinate the submittal of evaluation reports and document discrepancies and other system shortcomings. The required changes will then be implemented via the established change order process.

It is anticipated that initial system design, spectrum acquisition, and pilot projects, will be completed by the end of the calendar year 2000. Final system design, award of contract(s), and contract negotiation will be completed by the end of the calendar year 2002. The construction of the system including site acquisition and facilities development, and the initial phases of user implementation, should require an additional seven years, with a targeted completion of the end of the calendar year 2009. Remaining users would then migrate to the system as their existing systems reach the end of the their lifecycle. An overall depiction of the project timeline is included in Exhibit IV-1.

D. RISK MANAGEMENT

This section provides a discussion of the process the Steering Committee and the Project Manager will use throughout the lifecycle of this project to identify and evaluate project risk. Included is an identification of current project risks, as well as a summary of the results of the risk management process as applied to the identified risks.

Risk Management Methodology

Risks are defined as factors that could interfere with the successful completion of a project. By continuously recognizing, analyzing, and assessing existing and potential risks, the Project Manager will be able to develop contingency plans designed to mitigate potential problems. To do so, the following four tasks must be accomplished on a continual basis, starting from the pre-implementation planning stages of the project, and adjusted to address the current environment as the life-cycle of the project evolves:

- ***Risk Identification*** – Risk identification recognizes and documents the risks that could affect the successful completion of the project.

- ***Risk Analysis –*** Risk analysis assigns a level of probability of occurrence (high, medium, or low) to the identified risks. This analysis is conducted independent of the effect the respective risk may have on the successful completion of the project.

- ***Risk Quantification*** – Risk quantification identifies the costs to the project (high, medium, or low) should the risk occur. These "costs" are not always monetary in nature, but rather are those costs which could be monetary or which could affect the project schedule or other project related activities.

- ***Risk Mitigation Planning and Response*** – The risk mitigation planning process allows the Program Manager to manage the occurrence of an identified risk. The Steering Committee will make decisions on how to respond to particular events and the Program Manager will carry these decisions forward. In this way, both the Project Manager and the Steering Committee share the responsibility for these tasks. Event responses may range from non-response to implementation of contingency plans.

Current Risk Management Environment

Risks to a project of this magnitude and scale will vary over the lifecycle of the project. Using the above methodology, the Steering Committee completed an evaluation, and identified seven key risk categories. They are:

- ***Spectrum*** – Risks related to spectrum include:

  1. Sufficient spectrum will not be made available.
  2. Project will be delayed until it is known which portion of spectrum will be used.
  3. Spectrum resources will not be available when needed (timeliness).
  4. Regional coordination issues will result in the State not receiving sufficient spectrum, in contiguous allocations, to accomplish statewide communications.

  At this stage of the project, the acquisition of sufficient spectrum is one of the most critical elements to the project's success and directly affects the project's ability to move forward.

  Risk mitigation plan – The Committee will continue to monitor emerging developments related to the FCC's plans for allocation of new spectrum. To minimize the risks associated with spectrum acquisition, the Steering Committee will continue to work with the Federal Communications Commission (FCC) and other political entities. Lastly, as proof of the departments' commitment to implement a shared, statewide system, the State will file frequency license applications as early as possible to ensure that State interests are best served. The State has formed a subcommittee (populated by members of the project's Steering Committee) to accomplish these tasks.

  Less desirable contingency plans would need to be considered in the event that sufficient spectrum, in contiguous portions of the spectrum, cannot be obtained. These plans will include evaluating the impact on department effectiveness and public safety service levels that a lack of spectrum will generate. The Steering Committee will then reprioritize project objectives to support the most critical department requirements with the available spectrum.

- ***Technology –*** A number of technology related risks exist. They include:

1. Potential exists for early obsolescence of the technology selected.
2. Project delays will occur due to concerns over implementation of certain technologies.
3. Costs will increase due to the proprietary nature of current technology.

Risk mitigation plan – To minimize the effects of the above risks, the State will clearly define its operating specifications and require that vendors supply state-of-the-art, proven, and supported technology. In addition, by ensuring equipment warranties, guarantees for replacement parts, and clauses preventing unexpected multi-year cost-escalations are included in all contracts, much of the risk associated with system technology will be mitigated.

Other efforts to minimize technology-related risks include continued support for standards (which aid in generating competition in the marketplace), compliance with federal, regulations (e.g. FCC and Occupational Safety and Health Administration (OSHA) regulations), and developing strong partnerships with vendors. The State will dedicate an Assistant Project Manager to ensure there is a focus on these tasks.

- ***Project Scope*** – The following risk is associated with the scope of the project:

  1. The logistical complexity of the project may create very difficult problems (e.g., staging materials/hardware for deployment at great many radio sites) for managers to handle efficiently and in a cost-effective manner.

  Risk mitigation plan – To mitigate this risk, the State will continue the strong, detailed planning efforts that have been conducted thus far. As part of this planning process, the State intends to study lessons learned from other, similar projects, compare benchmarking studies, and hire external experts, while at the same time, continually developing the internal expertise of its own staff. To show proof of design concepts, the State intends to implement smaller scale pilot projects to test assumptions and to gain expertise.

- ***Real Estate*** – Two major risks associated with real estate are:

  1. Inability to acquire the necessary sites for vaults and towers.
  2. Incurring significant project delays due to the inability to acquire the necessary sites in a timely manner. “Road blocks” could occur because of politics, current land holdings, or other environmental concerns.

  Risk mitigation plan – The most effective means the State has to combat real estate risks is to identify as many alternate sites as possible. Once the sites have been identified, effort will be spent on assessing the political environment, educating the public on project objectives, and researching the site acquisition processes used by other entities (e.g. cellular telephone companies, personal communications services (PCS) providers, etc.). Other efforts regarding mitigation of real estate risk, as they relate to the environment, are to ensure strict

adherence to local, State, and federal environmental statutes. The State will designate an Assistant Project Manager to work issues associated with real estate risk.

- ***Politics*** – The political arena holds many risks for the project. The most important of these risks are:

    1. Potential for the breakdown of the partnership of the participating departments.
    2. Potentially inconsistent support ensuing administrations will give to the project.
    3. Local, federal, or possibly even commercial sector sentiments swaying legislators to drop support for the project.
    4. Project not receiving support because public safety communications systems are not recognized as important infrastructures.

    Risk mitigation plan – To minimize these risks, the Steering Committee will continue its strong efforts in educating Administration and Department Directors concerning project objectives, and will continue collaborative planning efforts with user departments to ensure support for unique requirements. Also, maintaining open dialogue with vendors and other commercial entities will mitigate problems regarding project objectives and future plans.

- ***State Growth Rate*** – There is one major risk associated with State growth rate estimations:

    1. State growth rate may exceed current estimates. Since requirements for designing systems capable of supporting expected channel loading is strongly dependent on the number of citizens requiring public safety support services, any excessive growth could adversely affect system designs based on initial projections.

    Risk mitigation plan – To avoid risks associated with estimations of State growth rates, it will be necessary to closely monitor census and immigration information. Additional data correlating to the State's growth rate includes development, new job creation, and other economic indicators. System technical solutions can be developed to be scalable and modular to accommodate higher than expected levels of growth. Technical specifications for the number of base stations (i.e. transmitter/receivers), the equipment needed to ensure that radio channels are not overly congested and are designed to support specific numbers of users. By tracking information regarding the inflow of people into the State, it will become evident how many public safety providers will be necessary to maintain appropriate levels of service, and how much hardware will be required to support the specified number of personnel.

- ***Funding*** – Funding sources remain uncertain and contingent on numerous entities. The risks associated with funding are:

1. Sufficient funding will not be made available to support the successful achievement of project objectives.
2. If funding sources are not identified and funding is not made available, the State will not acquire sufficient spectrum allocations to support statewide operations.
3. Inadequate cost estimation due to evolving/changing department requirements, technological developments, and spectrum related issues.
4. Inconsistent funding throughout the lifecycle of the project.

Risk mitigation plan – The Steering Committee will designate a subcommittee that will focus its efforts on reducing risks associated with project funding. This subcommittee will continue to educate decision-makers concerning the importance of the successful completion of the project. An emphasis will be placed on the effect that a lack of funding will have on public safety service levels to the citizens (and visitors) of the State of California. Support will be sought from all levels of government from the current executive administration to the local level. With top-down and bottom-up support for the project, continued funding will be more likely to be made available.

- ***Schedule –*** Several risks are associated with project schedule, they are:

1. Project may incur significant schedule delays before another source of new spectrum can be identified if the State misses the FCC's deadline for submitting license requests for spectrum. The criticality associated with the timely execution of the licensing process cannot be overemphasized.
2. Not allotting sufficient time for site acquisition. The development of sites will be the next critical path item after the acquisition of sufficient spectrum.
3. If funds are not identified and made available in a timely manner, the FCC may not grant licenses for sufficient, contiguous spectrum.
4. Legal protests levied by unknown (at this time) sources could cause significant schedule delays while cases are litigated.
5. Inability to implement new technology (due to inability to acquire necessary spectrum, acquire sites, etc.), in a timely manner, will result in adverse effects on public safety department operations.

Risk mitigation plan - The most effective means to minimize schedule risk is to develop detailed plans. The State is currently conducting this effort, and will continue them throughout the lifecycle of the project. To properly plan for the two current critical path items, the State has taken the initiative to form planning subcommittees strictly focused on these efforts. A Spectrum Acquisition Subcommittee has been formed to accomplish the tasks necessary to license the needed spectrum and to monitor developments related to the spectrum environment. To help mitigate the potential for schedule risk, specifically with regard to site acquisition and development, the State will assign an Assistant Project Manager to coordinate the activities associated with legal/real estate issues with the appropriate entities.

A summary of the results of the Risk Management process outlined in the above paragraphs is shown, in Exhibit IV-2.

SECTION IV

EXHIBITS

THE WARNER GROUP

State of California
Public Safety Radio Communications Project
Preliminary Project Timeline

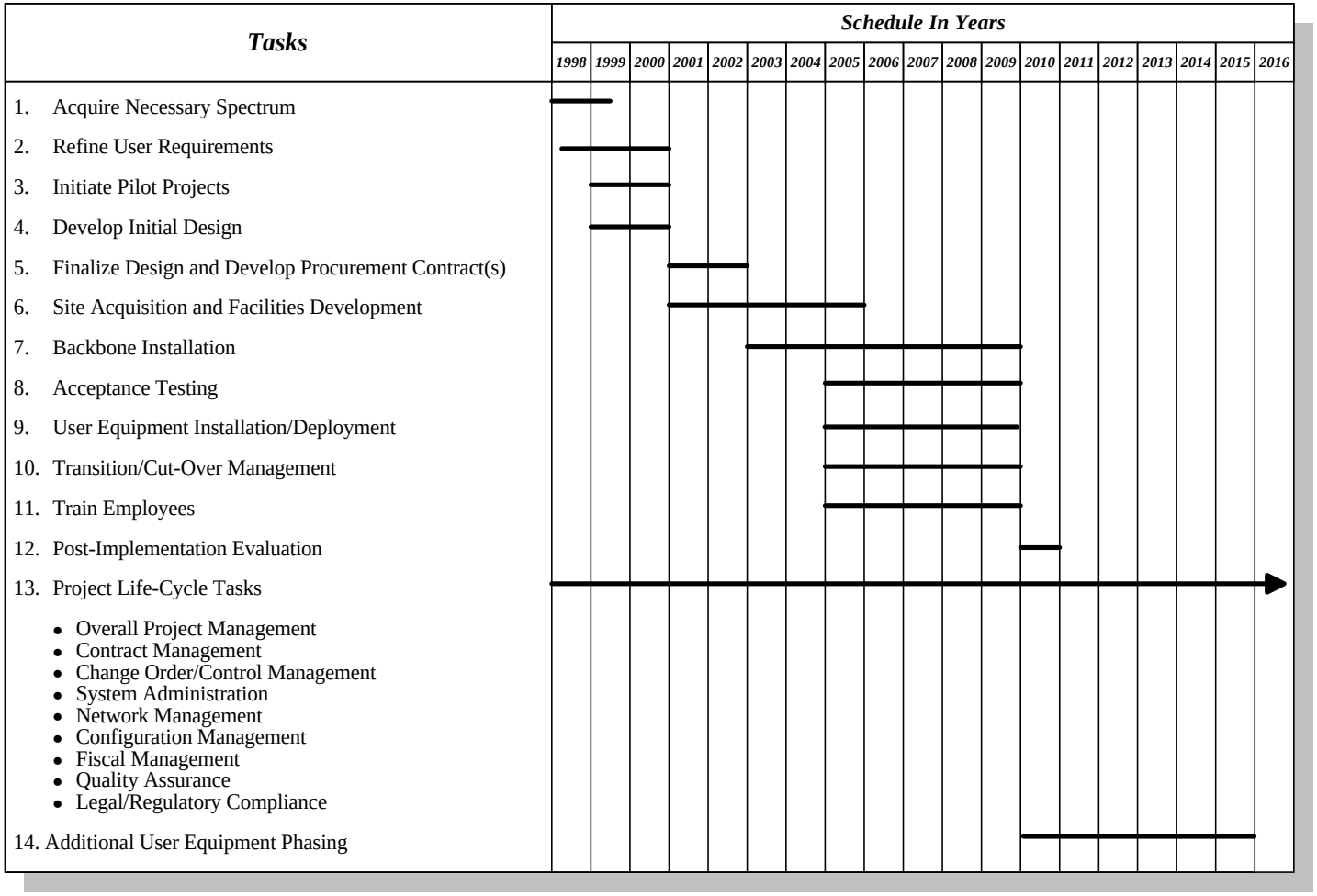


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Exhibit IV-2

State of California
Risk Management
Risk Assessment Summary

Risk Category	Probability of Risk Occurrence	Potential Impact on Project	Risk Mitigation Plan
Spectrum			Continue vocal lobbying efforts and continue to monitor emerging developments. File early for radio licenses to show strong commitment to project success. If sufficient spectrum is not acquired: Steering Committee will evaluate impact of lesser amount of spectrum and reprioritize project objectives to support only the most critical department needs to ensure public safety service
1 Sufficient spectrum will not be made available	High	High	
2 Project will be delayed until it is known which portion of spectrum will be used	High	Medium	
3 Spectrum resources will not be made available when needed	Medium	High (Localized)	
4 Regional planning issues may cause State to not receive sufficient spectrum in contiguous allocations	Low	Low	
Technology			Clearly define desired operating specifications. Ensure equipment warranties, replacement parts guarantees, and clauses preventing multi-year cost-escalations are included in all contracts. Comply with all FCC and OSHA standards.
1 Potential early obsolescence of the technology selected	Low	Low	
2 Project delays due to health concerns driven by implementation of certain technologies	High	Low	
3 Increased costs due to proprietary nature of current technology	Medium	High	
Project Scope			Continue rigorous planning efforts. Study lessons learned from other, similar projects, as well as benchmarking studies. Show proof of design concepts by implementing pilot projects.
1 Logistical complexity may create very difficult problems for management to handle efficiently and in a cost-effective manner	Medium	High	
Real Estate			Identify alternate sites. Study site acquisition processes used by other entities (e.g. cellular telephone, PCS, etc.). Educate public on project need and safety precautions.
1 Will incur significant delays in acquiring necessary sites	High	High	
2 Will not acquire necessary sites	High	Medium	
Politics			Educate Administration and Department Directors. Continue to engage in collaborative planning efforts with all users. Maintain open dialogue with other government entities and potential vendors.
1 Potential discontinuance of 10 department collaboration	Low	High	
2 Timeframe for project will span several administrations, and there is no certainty of the importance others will place on the project	High	Low/Medium	
3 Local/federal/commercial sentiments swaying decisions by legislators	High	Low	
4 Project not receiving support because public safety communications systems are not recognized as important infrastructures	High	Medium	
State Growth Rate			Closely monitor census statistics and other growth indicators (e.g. housing and job markets).
1 State growth rate may exceed estimates	Low	Low	
Funding			Educate decision makers on importance of project. Place heavy emphasis on effect the lack of funding will have on service levels to citizens and visitors to the State. Continue to refine cost estimates as additional information becomes available.
1 Sufficient funding will not be made available to complete project	High	High	
2 Spectrum acquisition dependent on demonstration of ability to provide funding	High	High	
3 Inadequate cost estimation due to evolving/changing agency requirements, technological developments, and spectrum issues	High	High	
4 Inconsistent funding throughout project life-cycle	Low	High	
Schedule			Accomplish detailed planning efforts. Form proactive subcommittees to focus on critical path issues such as acquisition of sufficient spectrum and acquisition and development of necessary radio sites. Assign single focal point for all project issues to maintain continuity and smooth flow of project schedule.
1 Inability to meet spectrum acquisition deadlines	High	High	
2 Site acquisition lead time is lengthy	High	High	
3 Must prove ability to fund before FCC will allocate spectrum	Medium	High	
4 Legal protests causing delays	Medium	Medium/High	
5 CHP must meet critical need ASAP	High	High	

APPENDICES

STATE OF CALIFORNIA
PUBLIC SAFETY RADIO COMMUNICATIONS
COST BENEFIT ANALYSIS

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APPENDIX A

AGENCY UNIQUE REQUIREMENTS

THE WARNER GROUP

APPENDIX A
AGENCY UNIQUE REQUIREMENTS

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APPENDIX A – AGENCY UNIQUE REQUIREMENTS

This section identifies unique agency requirements and specific hardware features for voice and data communications. These requirements were developed during focus group meetings and individual interviews and are not in order of priority.

California Highway Patrol - Voice Communications

- Overall system replacement
- Consolidation of State Police and Highway Patrol systems
- Portable talk-in to dispatch capability
- In-vehicle portable battery recharging
- Physical durability of equipment
- Long portable battery life
- Inside building coverage
- Smaller, lightweight equipment
- Multi-band capability for interoperability
- Concealability
- Transmission time-out feature to minimize channel blocking
- Hands free operation
- Multi-functional (i.e., radio, telephone, pager, etc.)
- Support for mobile command posts

California Highway Patrol - Mobile Data

- Provide subject identification information in the field
- Access to local agency criminal justice information
- Access to CAD incident status information
- "Heads up" in-vehicle display
- Magnetic stripe driver's license reader

California Department of Corrections - Voice Communications

- In-vehicle portable battery recharging
- Concealability
- Compatibility between divisions within department
- Flexibility in departmental channel assignments
- Compatibility between mobile and portable radios
- Standardized operating features and accessories
- Multi-functional (i.e., radio, telephone, pager, etc.)

- Access to 24-hour regional dispatch center support
- Local office access to radio network

California Department of Corrections - Mobile Data

- Access to state, federal, and local agency databases
- Field access to subject photograph, case background and custody information
- Single unit for both voice and data communications

Department of Fish and Game - Voice Communications

- 99% service area coverage
- Long portable battery life (e.g., 16 hours)
- Durability and water resistance
- Intrinsically safe radios
- Standardized equipment and operating features
- Multi-functional (i.e., radio, telephone, pager, etc.)
- Field programmable for features and channelization
- Selectable talk-back and scanning features
- Support for mobile command centers

Department of Fish and Game - Mobile Data

- Access to dispatch and local law enforcement information
- "Heads up" in-vehicle display

California Department of Forestry and Fire Protection- Voice Communications

- Flexibility and agility in responding to disaster communication needs
- Durability and weather resistance
- Long portable battery life
- Field programmable for features and channelization
- Unit identification
- Alpha-numeric displays; large and visible controls
- Support for mobile command posts

California Department of Forestry - Mobile Data

- Access to hazardous materials information
- Access to Fire report information, including
  - Incident activity summaries
  - Resource status and weather information
- Water source information

Department of Justice - Voice Communications

- Multiple tactical channels
- Concealability
- Lightweight
- Durable equipment
- Intrinsically safe radios
- Long portable battery life
- Compatibility with covert microphone and recording equipment
- Ease of programmability
- Standardized equipment and operating features
- Multi-functional (i.e., radio, telephone, pager, etc.)
- Explosion proof
- Alphanumeric readout of channel displays
- Access to 24-hour dispatch support

Department of Justice - Mobile Data

- Data and video image transmission capability
- Access to local and State criminal justice and law enforcement databases

Department of Parks and Recreation - Voice Communications

- Physical durability
- Water resistance
- Long portable battery life
- Small, lightweight equipment
- Field programmability
- Alphanumeric displays
- Hands free operation
- Multi-functional (i.e., radio, telephone, pager, etc.)
- Vehicle extension to portable radio
- Resistance to interference and background noise

Department of Parks and Recreation - Mobile Data

- Access to law enforcement and agency databases
- Image transmission capability

Department of Transportation - Voice Communications

- Direct interoperability with California Highway Patrol
- Wide area coverage
- Durable and weather resistant equipment
- Lightweight
- Multiband capability
- Standardized features and capabilities
- Concealable and secure vehicle mounting
- Alphanumeric channel displays
- Multi-functional (i.e., radio, telephone, pager, etc.)
- 24-hour statewide dispatch

Department of Transportation - Mobile Data

- Access to hazardous materials information
- "Heads up" in-vehicle display
- Text messaging and work order dispatch to field crews

Department of Water Resources - Voice Communications

- Long portable battery life
- Low battery indicator
- Small, lightweight equipment
- Standardized equipment and features
- Hands free operation
- Multi-functional (i.e., radio, telephone, pager, etc.)
- Wide area coverage
- 24-hour dispatch center support

Department of Water Resources - Mobile Data

(None identified at this time)

California Youth Authority - Voice Communications

- Coverage within institutions and medical facilities
- Long portable battery life
- Small, lightweight equipment
- Weather proof
- Multi-band capability
- Covert operating capabilities
- Hands free operation
- Visible controls

- Multi-functional (i.e., radio, telephone, pager, etc.)

California Youth Authority - Mobile Data

- Photographic image transmission to field
- Parole field reporting

Governor's Office of Emergency Services - Voice Communications

- Physical durability
- Long portable battery life
- Lightweight
- Multi-band capability
- Alphanumeric channel displays
- Hands free operation
- Field programmable
- Multi-functional (i.e., radio, telephone, pager, etc.)
- Access to Public Switched Telephone Network

Office of Emergency Services - Mobile Data

- Data and video transmission capability

APPENDIX B

ALTERNATIVE 1 – AGENCY BASELINES

THE WARNER GROUP

APPENDIX B
ALTERNATIVE 1 – AGENCY BASELINES

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CALIFORNIA HIGHWAY PATROL

California Highway Patrol	
Frequencies	• VHF Low Band (39/42 MHz) – 39 frequency pairs • VHF High Band (154 MHz) – portable radio repeaters • UHF Band – five frequency pairs • Data – commercially provided in some areas of State (RAM Mobile Data) *Usage Agreements (Cooperators)* • See following pages *Mutual Aid Systems In Use* • California Law Enforcement Radio System (CLERS) • California Law Enforcement Mutual Aid Radio System (CLEMARS) • California On-Scene Emergency Coordination Radio Plan (CALCORD) • National Law Enforcement Mutual Aid Radio System (NALEMARS)
Facilities and Equipment	• 7,420 mobile radios and repeaters • 4,826 portable radios and repeaters • 1,830 fixed stations and receivers • 1,700 pagers • 700 cellular telephones • 127 remote control units
Equipment Age/Life Cycle	• Fixed Equipment (includes fixed stations and receivers, and mobile relays) - 30% over 15 years of age - 33% between 11 and 15 years of age • Mobile Radios - 94% between 6 and 10 years of age - 4% new to 5 years of age • Portable Radios - 99% new to 5 years of age - 1% between 6 and 10 years of age • Cellular Telephones - 70% new to 5 years of age - 29% between 6 and 10 years of age

Department of California Highway Patrol
List of Frequency Use Agreements

FEDERAL AGENCIES

U.S. Air Force
U.S. Army
U.S. Marine Corps
U.S. Navy
U.S. Department of Justice
U.S. Border Patrol
U.S. Bureau of Land Management
U.S. Secret Service
U.S. State Department
Defense Logistics Agency
Energy Research and Development Administration
Federal Bureau of Investigation
National Auto Theft Bureau
National Park Service

COUNTIES

Alameda County
Colusa County
Contra Costa County
El Dorado County
Fresno County
Glenn County
Humboldt County
Kern County
Kings County
Los Angeles County
Marin County
Mendocino County
Modoc County
Mono County
Monterey County
Orange County
Placer County
Riverside County
Sacramento County
San Bernardino County
San Diego County
City and County of San Francisco
San Joaquin County
San Luis Obispo County
San Mateo County
Santa Barbara County
Shasta County
Sierra County
Siskiyou County
Sonoma County
Stanislaus County
Tehama County
Ventura County
Yolo County

CITIES

City of Bakersfield
City of Berkeley
City of Brawley
City of Clearlake
City of Cotati
City of Escondido
City of Fresno
City of Inglewood
City of Los Angeles
City of Manteca
City of Martinez
City of Modesto
City of Morro Bay
City of Mount Shasta
City of Oakland
City of Pismo Beach
City of Redding
City of Richmond
City of Sacramento
City of Santa Barbara
City of Tulare
Port of Stockton
San Francisco Airports Commission
Nevada Highway Patrol

CURRENT LIST of CHP SYSTEM USERS
(Receive Dispatch Center Support)

Office of Emergency Services
Office of Court Security - Judicial Council of California
Department of Toxic Substances Control
Public Employees Retirement System
California Exposition and State Fair
California Horse Racing Board
Consumer Affairs
Employment Development Department
Department of Corporations
Department of Insurance - Bureau of Fraud Claims
Department of Justice - Bureau of Medi-Cal Fraud
Department of Health Services - Audits and Investigations
Alcoholic Beverage Control
Department of Health Services - Food and Drug Branch - STAKE Program
Department of Motor Vehicles
California Department of Corrections - Parole and Community Services

AGENCIES AUTHORIZING DEPARTMENT of CALIFORNIA HIGHWAY PATROL USE of FREQUENCIES

Portable Extenders Frequency

Adelanto Police Department
Alpine County Sheriff
Alturas Police Department
Amador County Sheriff
Anderson Police Department
Arcata Police Department
Banning Police Department
Beaumont Police Department
Benicia Police Department
Bishop Lone Pine Fire Department
Bishop Police Department
Blythe County Sheriff
Blythe Police Department
Brawley Police Department
Butte County Fire & Medic
Butte County Sheriff
California Department of Forestry
CDF/San Luis County Fire
Celexico Police Department
Chico Police Department
Clearlake Police Department
Coachella Police Department
Colusa County Sheriff
Colusa Police Department
Del Norte County Sheriff
Department of Fish & Game
Department of Forestry
Department of Justice (DOJ)
Dixon Police Department
Dorris Police Department
Dunsmuir Police Department
El Cajon Police Department
El Centro Police Department
Eureka Police Department
Fort Bragg Police Department
Fortuna Police Department
Glenn County Fire Department
Glenn County Sheriff
Gridley Police Department
Hemet Police Department
Holtville Police Department
Humboldt County Sheriff
Imperial County Sheriff
Imperial Police Department

Indio Police Department
Inyo County Sheriff
La Mesa Police Department
Lake County Sheriff
Lassen County Sheriff
Mammoth Lakes Police Department
Mariposa County Sheriff
Medi Flight
Mendocino County Sheriff
Mono County Sheriff
Mt. Shasta County Road Department
Mt. Shasta County Sheriff
Mt. Shasta Police Department
Napa Ambulance
Napa County Fire
Napa County Sheriff
Napa Police Department
Nevada County Sheriff
Oregon State Police
Oroville Police Department
Paradise Police Department
Placer County Sheriff
Plumas County Sheriff
Red Bluff Police Department
Riverside County Sheriff
San Bernardino County Sheriff
San Diego Fire Department
San Jacinto Police Department
San Joaquin County Fire
Santa Cruz County Sheriff
Siskiyou County Sheriff
Solano County Sheriff
Sonora Police Department
South Lake Tahoe Police Department
Stanislaus County Sheriff
Tehama CDF
Tehama County Sheriff
Trinity County Sheriff
Tulelake Police Department
Tuolumne County Sheriff
U.S. Border Patrol
Vacaville Police Department
Vallejo Police Department
Weed Police Department
Williams' Police Department
Yreka Police Department

Car Mobile Frequency

Department of Transportation (CalTrans)
Grass Valley Police Department
Las Vegas Police Department
Nevada City Police Department
Nevada County Sheriff
Reno Police Department

Department of California Highway Patrol
Radio Equipment Age Distribution

[This file is from requirements_final_radio_equipment_age_distribution.wpd]

CALIFORNIA HIGHWAY PATROL

California Highway Patrol FY 1997-1998 Budget	
Item	***Budget***
Engineering	$5,606,000
Unit Costs	$3,947,000
[1]Microwave	$4,481,000
[2]Technician	$2,339,000
[3]Other	$443,000
MSA/Strategic Plan	$169,000
[4]FY 97-98 DGS Budget	***$16,985,000***
[5]Agency Reported Total (9/97)	***$27,067,000***

[1] Includes maintenance, depreciation, and additional equipment (if any).
[2] Includes VHF installation and maintenance.
[3] Includes miscellaneous flow-through costs and CMARS.
[4] DGS Budget reflects Rate Book totals.
[5] Total reflects all Telecommunications cost items budgeted by Agency.

Approved BCPs:

- Feasibility study report for Computer Aided Dispatch
- Coverage and loading study for an 800 MHz trunked radio system

DEPARTMENT OF CORRECTIONS

Department of Corrections	
Frequencies	• VHF Low Band – mobile radios • VHF High Band – portable radios • UHF Band – portable radios • 800 MHz Band – 25 trunked systems *Usage Agreements (Cooperators)* • See following pages *Mutual Aid Systems In Use* • California Emergency Service Radios System (CESRS) • California Law Enforcement Mutual Aid Radio System (CLEMARS) • California Law Enforcement Radio System (CLERS) • California Multi-agency Radio System (CMRS) • California On-Scene Emergency Coordination Radio System (CALCORD)
Facilities and Equipment	• 6,671 portable radios • 703 mobile radios • 280 base stations and receivers • 96 remote control units • 600 cellular telephones • 250 pagers
Equipment Age/Life Cycle	• Fixed Equipment (includes fixed stations and receivers, and mobile relays) - 75% new to 5 years of age - 68% between 6 and 10 years of age • Mobile Radios - 74% between 6 and 10 years of age - 22% new to 5 years of age • Portable Radios - 62% between 6 and 10 years of age - 37% new to 5 years of age • Cellular Telephones - 100% new to 5 years of age • Pagers - 100% new to 5 years of age

Department of Corrections
List of Frequency Use Agreements

Amador County Sheriff
Anderson Police
Arcata Police
Arroyo Grande Police
Arvin Police
Atascadero Police
Bakersfield Police
Benicia Police
Blythe Police
Brawley Police
Butte Sheriff
Calaveras Sheriff
Calexico Police
California City Police
Carlsbad Police
Carpinteria Police
Cathedral City Police
Ceres Police
Chico Police
Chowchilla Police
Chula Vista Police
Clearlake Police
Clovis Police
Coachella Police
Colusa Sheriff
Contra Costa Sheriff
Corcoran Police
Corning Police
Coronado Police
Del Norte Sheriff
Del Rey Oaks Police
Desert Hot Springs
Dinuba Police
East Palo Alto Police
El Cajon Police
El Centro Police
El Dorado Sheriff
Escalon Police
Escondido Police
Eureka Police
Fairfield Police
Fremont Police
Fresno Police
Gilroy Police
Glenn Sheriff
Gonzales Police
Grass Valley Police
Greenfield Police
Guadalupe Police
Hanford Police
Hayward Police
Healdsburg Police
Hollister Police
Holtville Police
Humboldt Sheriff
Huron Police
Imperial County Sheriff
Indio Police
Inyo County Sheriff
Kern County Sheriff
King City Police
Kings County Sheriff
Kingsburg Police
La Mesa Police
Lake Sheriff
Lakeport Police
Lassen County Sheriff
Lodi Police
Madera County Sheriff
Manteca Police
Marin County Sheriff
Marina Police
Marysville Police
Mendocino County
Sheriff
Mendota Police
Modesto Police
Mono Police
Monterey County Sheriff
Morro Bay Police
Napa City Police
Napa County Sheriff
Nevada County Sheriff
Oceanside Police
Oroville Police
Oxnard Police
Pacific Grove Police
Paradise Police
Paso Robles Police
Petaluma Police
Pismo Beach Police
Placer County Sheriff
Placerville Police
Plumas County Sheriff
Red Bluff Police
Redwood City Police
Reedley Police
Richmond Police
Ridgecrest Police
Ripon Police
Rohnert Park Public
Safety
Sacramento County
Sheriff
Sacramento Police
Salinas Police
San Benito County
Sheriff
San Diego Police
San Diego Sheriff
San Francisco Police
San Joaquin Sheriff
San Leandro Police
San Luis Obispo Police
San Mateo County Sheriff
Santa Barbara Police
Santa Barbara Sheriff
Santa Clara Sheriff
Santa Cruz Sheriff
Santa Maria Police
Santa Paula Police
Santa Rosa Police
Seaside Police
Sebastopol Police
Selma Police
Shafter Police
Shasta County Sheriff
Sierra County Sheriff
Simi Valley Police

Siskiyou County Sheriff
South Lake Tahoe Police
Solano County Sheriff
Soledad Police
Sonoma County Sheriff
Stallion Springs Police
Stanislaus County Sheriff
Stockton Police
Taft Police
Tehama Sheriff
Tracy Police
Trinity Sheriff
Tulare Police
Ukiah Police
Union City Police
Vallejo Police
Ventura Police
Ventura Sheriff
Yuba Police
Yuba Sheriff

Department of Corrections
Radio Equipment Age Distribution

[This file is from requirements_final_radio_equipment_age_distribution.wpd]

DEPARTMENT OF CORRECTIONS

Department of Corrections FY 1997-1998 Budget	
Item	***Budget***
Engineering	$1,435,000
Unit Costs	$560,000
[1]Microwave	$0
[2]Technician	$304,000
[3]Other	$1,146,000
MSA/Strategic Plan	$29,000
[4]***FY 97-98 DGS Budget***	***$3,474,000***
[5]***Agency Reported Total (10/97)***	***$5,050,000***

[1] Includes maintenance, depreciation, and additional equipment (if any).
[2] Includes VHF installation and maintenance.
[3] Includes miscellaneous flow-through costs and CMARS.
[4] DGS Budget reflects Rate Book totals.
[5] Total reflects all Telecommunications cost items budgeted by Agency.

DEPARTMENT OF FISH AND GAME

Department of Fish and Game	
Frequencies	• VHF Low Band • VHF High Band • 800 MHz Band • UHF Band • Single Sideband – AM signal, and VHF-FM signal • Radar – navigation tool *Usage Agreements (Cooperators)* • Multiple federal, state, and local government agencies *Mutual Aid Systems In Use* • California Law Enforcement Mutual Aid Radio System (CLEMARS) • National Law Enforcement Mutual Aid Radio System (NALEMARS) • California On-Scene Emergency Coordination Radio System (CALCORD)
Facilities and Equipment	• 748 mobile radios • 541 portable radios • 76 mobile relays • 52 fixed stations • 23 remote control units • 400 cellular phones • 500 pagers
Equipment Age/Life Cycle	• Fixed Equipment (includes fixed stations and receivers, and mobile relays) - 67% new to 5 years of age - 33% between 6 and 10 years of age • Mobile Radios - 63% between 6 and 10 years of age - 25% new to 5 years of age • Portable Radios - 60% between 6 and 10 years of age - 40% new to 5 years of age • Cellular Telephones - 100% new to 5 years of age • Pagers - 100% new to 5 years of age

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DEPARTMENT OF FISH AND GAME

Department of Fish and Game 1997-1998 Budget	
Item	***Budget***
Engineering	$396,000
Unit Costs	$231,000
[1]Microwave	$254,000
[2]Technician	$159,000
[3]Other	$53,000
MSA/Strategic Plan	$15,000
[4]FY 97-98 DGS Budget	***$1,108,000***
[5]Agency Reported Total (8/97)	***$1,555,000***

[1] Includes maintenance, depreciation, and additional equipment (if any).
[2] Includes VHF installation and maintenance.
[3] Includes miscellaneous, flow-through costs.
[4] DGS Budget reflects Rate Book totals.
[5] Total reflects all Telecommunications cost items budgeted by Agency.

DEPARTMENT OF FORESTRY AND FIRE PROTECTION

Department of Forestry and Fire Protection	
Frequencies	• VHF Low Band – Chief Officer communications • VHF High Band – Forestry Conservation Bands • UHF Band – portable radios • 800 MHz – conventional radios *Usage Agreements (Cooperators)* • California Highway Patrol • Department of Corrections • Department of Fish and Game • Department of Water Resources • U.S. Forest Service • Los Angeles City Fire (Los Angeles County Fire • Ventura County Fire • Many local agencies *Mutual Aid Systems In Use* • California On-Scene Emergency Coordination Radio System (CALCORD)
Facilities and Equipment	• 2,450 portable radios • 2,020 mobile radios • 773 fixed stations and receivers • 285 remote control units • 200 mobile relays • 700 cellular telephones • 1,200 pagers
Equipment Age/Life Cycle	• Fixed Equipment (includes fixed stations and receivers, and mobile relays) - 50% new to 5 years of age - 50% between 6 and 10 years of age • Mobile Radios - 97% between 6 and 10 years of age - 3% new to 5 years of age • Portable Radios - 84% between 6 and 10 years of age - 16% new to 5 years of age • Cellular Telephones - 100% new to 5 years of age • Pagers - 100% new to 5 years of age
Satellite Communications	• Remote Automate Weather System (RAWS) – 84 data collection platforms • Geo-stationary Operational Environmental Satellite (GOES) – uplink • Resources Building – downlink • National Oceanic and Atmospheric Administration (NOAA) - coordinators

[This file is from requirements_final_radio_equipment_age_distribution.wpd]

DEPARTMENT OF FORESTRY AND FIRE PROTECTION

Department of Forestry and Fire Protection FY 1997-1998 Budget	
Item	***Budget***
Engineering	$3,083,000
Unit Costs	$2,560,000
[1]Microwave	$1,824,000
[2]Technician	$1,747,000
[3]Other	$2,521,000
MSA/Strategic Plan	$97,000
[4]FY 97-98 DGS Total	***$11,832,000***
[5]Agency Reported Total (9/97)	***$10,700,000***

[1] Includes maintenance, depreciation, and additional equipment (if any).
[2] Includes VHF installation and maintenance.
[3] Includes miscellaneous flow-through costs and CMARS.
[4] DGS Budget reflects Rate Book totals.
[5] Total reflects all Telecommunications cost items budgeted by Agency.

DEPARTMENT OF JUSTICE

Department of Justice	
Frequencies	• VHF High Band – one pair and one simplex channel • UHF Band *Usage Agreements (Cooperators)* • See following pages *Mutual Aid Systems In Use* • California Law Enforcement Mutual Aid Radio System (CLEMARS)
Facilities and Equipment	• 652 mobile radios • 504 portable radios • 86 fixed stations • 29 remote control units • 30 mobile relays • 400 cellular telephones • 600 pagers
Equipment Age/Life Cycle	• Fixed Equipment (includes fixed stations and receivers, and mobile relays) - 82% between 6 and 10 years of age - 16% new to 5 years of age • Mobile Radios - 67% between 6 and 10 years of age - 33% new to 5 years of age • Portable Radios - 39% between 6 and 10 years of age - 21% new to 5 years of age • Cellular Telephones - 100% new to 5 years of age • Pagers - 100% new to 5 years of age

Department of Justice
List of Frequency Use Agreements

The following federal, state and local agencies have mutual agreements with the Department of Justice to utilize DOJ's frequencies. Additionally, DOJ has agreements from these agencies to utilize their frequencies in DOJ radios.

FEDERAL AGENCIES

Alcohol, Tobacco and Firearms
Federal Bureau of Investigations
U.S. Army National Guard
U.S. Border Patrol
U.S. Customs
U.S. Drug Enforcement Agency
U.S. Naval Investigative Service

STATE AGENCIES

Department of California Highway Patrol
Department of Forestry and Fire Protection
Department of General Services
Office of Emergency Services
University of California

LOCAL AGENCIES

San Diego

San Diego Harbor Police Department
San Diego Police Department
Escondido Police Department
Oceanside Police Department
El Cajon Police Department
Carlsbad Police Department

Los Angeles

Los Angeles Police Department
Los Angeles Sheriffs
Azusa Police Department
Baldwin Police Department
Bell Police Department
Compton Police Department
Covina Police Department
Downey Police Department
Glendora Police Department
Maywood Police Department
Monrovia Police Department
Monterey Park Police Department
Sierra Madre Police Department
South Gate Police Department
Vernon Police Department

Fresno

Fresno Sheriffs
Kern County Sheriffs
Bakersfield Police Department
Merced Police Department
Reedley Police Department
Inyo Sheriffs
Bishop Police Department
Stanislaus Sheriffs
Mariposa Sheriffs
Los Banos Police Department
Atwater Police Department
Manteca Police Department
Modesto Police Department

* These agencies have not been granted permission to use DOJ frequencies.

San Jose

Santa Cruz Sheriffs
Santa Cruz Police Department
Sunnyvale Police Department
Capitola Police Department
Watsonville Police Department
Santa Clara Sheriffs
Morgan Hill Police Department
Gilroy Police Department
Monterey Police Department
San Benito Police Department
Scotts Valley Police Department

San Francisco County

Contra Costa Sheriffs
Alameda Cty Sheriffs
Mendocino Cty Sheriffs
Benicia Police Department
Dixon Police Department
Fort Bragg Police Department
Ukiah Police Department
Vallejo Police Department
Napa Sheriffs
Clearlake Police Department
San Leandro Police Department
Solano Sheriffs
Rio Vista Police Department
Suisin Police Department
Vacaville Police Department
Lake Cty Sheriffs
Lakeport Police Department

Sacramento

South Lake Tahoe Police Department
Douglas Cty Sheriffs
Alpine Cty Sheriffs
El Dorado Sheriffs
Tracy Police Department
Ripon Police Department
Gridley Police Department
Chico Police Department
Oroville Police Department
Paradise Police Department
Davis Police Department
Woodland Police Department
Yolo Cty Sheriffs
Solano Sheriffs
Sacramento Sheriffs
Sacramento Police Department

Redding

Trinity County Sheriffs
Del Norte Sheriffs
Siskiyou County Sheriffs
Lassen County Sheriffs
Tehama Sheriffs
Jackson & Josephine So (Oregon)
Oregon State Police Department

[This file is from requirements_final_radio_equipment_age_distribution.wpd]

DEPARTMENT OF JUSTICE

Department of Justice FY 1997-1998 Budget	
Item	***Budget***
Engineering	$38,000
Unit Costs	$208,000
[1]Microwave	$0
[2]Technician	$44,000
[3]Other	$35,000
MSA/Strategic Plan	$5,000
[4]FY 97-98 DGS Total	***$330,000***
[5]Agency Reported Total (7/97)	***$534,000***

[1] Includes maintenance, depreciation, and additional equipment (if any).
[2] Includes VHF installation and maintenance.
[3] Includes miscellaneous, flow-through costs.
[4] DGS Budget reflects Rate Book totals.
[5] Total reflects all Telecommunications cost items budgeted by Agency.

DEPARTMENT OF PARKS AND RECREATION

Department of Parks and Recreation	
Frequencies	• VHF High Band – two pairs • 800 MHz Band - 21 frequency pairs including 9 NPSPAC frequencies *Usage Agreements (Cooperators)* • San Diego Lifeguards • California Highway Patrol • Department of Fish and Game • Department of Forestry and Fire Protection • Governor's Office of Emergency Services *Mutual Aid Systems In Use* • National Park Service Systems • CLEMARS • CMARS • CLERS
Facilities and Equipment	• 970 mobile radios • 814 portable radios • 270 fixed stations and receivers • 126 mobile relays • 89 remote control units
Equipment Age/Life Cycle	• Fixed Equipment (includes fixed stations and receivers, and mobile relays) - 80% between 6 and 10 years of age - 11% new to 5 years of age • Mobile Radios - 57% between 6 and 10 years of age - 34% new to 5 years of age • Portable Radios - 82% between 6 and 10 years of age - 11% new to 5 years of age

[This file is from requirements_final_radio_equipment_age_distribution.wpd]

DEPARTMENT OF PARKS AND RECREATION

Department of Parks and Recreation FY 1997-1998 Budget	
Item	***Budget***
Engineering	$1,127,000
Unit Costs	$877,000
[1]Microwave	$345,000
[2]Technician	$297,000
[3]Other	$375,000
MSA/Strategic Plan	$29,000
[4]FY 97-98 DGS Total	***$3,050,000***
[5]Agency Reported Total (7/97)	***$3,360,000***

[1] Includes maintenance, depreciation, and additional equipment (if any).
[2] Includes VHF installation and maintenance.
[3] Includes miscellaneous flow-through costs and CMARS.
[4] DGS Budget reflects Rate Book totals.
[5] Total reflects all Telecommunications cost items budgeted by Agency.

Approved BCPs:

- FSR for CAD enhancement

DEPARTMENT OF TRANSPORTATION

Department of Transportation	
Frequencies	• VHF Low Band (47 MHz) – Highway Maintenance • VHF High Band • UHF Band • 800 MHz Band - conventional and trunked • Broadcast Amplifiers – AM radio signals • Marine Navigation System – 950 MHz Band • Radar Traffic Monitoring System • Remote Television Monitors – Closed Circuit Television (CCTV) • Traffic Control – 72 MHz RF link *Usage Agreements (Cooperators)* • California Highway Patrol • San Diego County *Mutual Aid Systems In Use* • None specified
Facilities and Equipment	• 12,239 mobile radios • 4,187 portable radios • 768 mobile relays • 593 fixed stations and receivers • 380 remote control units
Equipment Age/Life Cycle	• 60% of VHF Low Band equipment over 20 years of age • 30% of 800 MHz band equipment exceeding life expectancy

DEPARTMENT OF TRANSPORTATION

Department of Transportation FY 1997-1998 Budget	
Item	***Budget***
Engineering	$1,355,000
Unit Costs	$2,687,000
[1]Microwave	$1,466,000
[2]Technician	$1,744,000
[3]Other	$500,000
MSA/Strategic Plan	$87,000
[4]FY 97-98 DGS Total	***$6,839,000***
[5]Agency Reported Total (9/97)	***$10,413,000***

[1] Includes maintenance, depreciation, and additional equipment (if any).
[2] Includes VHF installation and maintenance.
[3] Includes miscellaneous, flow-through costs.
[4] DGS Budget reflects Rate Book totals.
[5] Total reflects all Telecommunications cost items budgeted by Agency.

[This file is from requirements_final_radio_equipment_age_distribution.wpd]

DEPARTMENT OF WATER RESOURCES

Department of Water Resources	
Frequencies	• VHF High Band – five pairs, Forestry Conservation Band • 800 MHz Band - 21 frequency pairs and 9 more NPSPAC frequencies *Usage Agreements (Cooperators)* • Mid-peninsula Regional Open Space district • Department of Fish and Game • Governor's Office of Emergency Services • California Conservation Corps • California Highway Patrol *Mutual Aid Systems In Use* •
Facilities and Equipment	• 791 mobile radios • 239 portable radios • 168 fixed stations and receivers • 53 remote control units • 28 mobile relays • 160 cellular telephones • 500 pagers
Equipment Age/Life Cycle	• Fixed Equipment (includes fixed stations and receivers, and mobile relays) - 86% new to 5 years of age - 14% between 6 and 10 years of age • Mobile Radios - 50% new to 5 years of age - 50% between 6 and 10 years of age • Portable Radios - 50% new to 5 years of age - 50% between 6 and 10 years of age • Cellular Telephones - 100% new to 5 years of age
Satellite Communications	• Geo-stationary Operational Environment Satellite

DEPARTMENT OF WATER RESOURCES

Department of Water Resources FY 1997-1998 Budget[1]	
Item	***Budget***
Engineering	$423,000
Unit Costs	$261,000
[2]Microwave	$239,000
[3]Technician	$218,000
[4]Other	$470,000
MSA/Strategic Plan	$19,000
[5]FY 97-98 DGS Total	***$1,630,000***
[6]Agency Reported Total (10/97)	***$2,014,000***

[1] Includes DWR two-way radio only (DWR telemetry related costs are not reflected as part of this budget).
[2] Includes engineering, maintenance, installation, and depreciation.
[3] Includes VHF installation and maintenance.
[4] Includes miscellaneous flow through and CMARS.
[5] DGS Budget reflects Rate Book totals.
[6] Total reflects all Telecommunications cost items budgeted by Agency.

DEPARTMENT OF THE YOUTH AUTHORITY

Department of the Youth Authority	
Frequencies	• VHF Low Band – mobile radios • VHF High Band – portable radios • UHF Band – portable radios • 800 MHz Band –trunked system *Usage Agreements (Cooperators)* • Local police and sheriff's agencies • Department of Forestry and Fire Protection • California Highway Patrol • Governor's Office of Emergency Services *Mutual Aid Systems In Use* • California Law Enforcement Mutual Aid Radio System (CLEMARS) • California Law Enforcement Radio System (CLERS)
Facilities and Equipment	• 1,169 portable radios • 193 mobile radios • 30 fixed stations and receivers • 28 remote control units • 400 cellular telephones
Equipment Age/Life Cycle	• Radio equipment ranges from new to over 15 years of age • Cellular telephones are new to under 5 years of age

DEPARTMENT OF THE YOUTH AUTHORITY

Department of the Youth Authority FY 1997-1998 Budget[1]	
Item	***Budget***
Engineering	$0
Unit Costs	$181,000
[2]Microwave	$0
Technician	$0
Other	$0
Capital Improvements	$0
FY 97-98 Total	***$181,000***
Agency Reported Total (8/97)	***No Change***

[1] While CYA is not allocated a pro-rata share of the DGS engineering and technical service budgets, the Department of General Services does provide these services for the Youth Authority on a project by project basis.
[2] Includes engineering, maintenance, installation, and depreciation.

Approved BCPs:

- FY 1997/98 - $839,000 to develop and install an 800 MHz trunked radio system for the Heman O. Stark Youth Correction facility in Chino.
- FY 1998/99 – Planned BCP $724,000 to develop and install an 800 MHz trunked radio system for the southern south correctional reception area and clinic in Norwalk.

[This file is from requirements_final_radio_equipment_age_distribution.wpd]

GOVERNOR'S OFFICE OF EMERGENCY SERVICES

Governor's Office of Emergency Services	
Frequencies	• HF – 2 to 8 MHz • VHF Low Band • VHF High Band • UHF Band • 800 MHz Band *Usage Agreements (Cooperators)* • All public safety organizations *Mutual Aid Systems In Use* • California On-Scene Emergency Coordination Radio Plan (CALCORD) • California Emergency Services Radio System (CESRS) • California Law Enforcement Mutual Aid Radio System (CLEMARS) • California Law Enforcement Radio System (CLERS) • Fire Mutual Aid Radio System (FIREMARS) • Fire White Radio System • Hospital Emergency Administrative Radio System (HEARS) • National Law Enforcement Mutual Aid Radio System (NALEMARS) • OES Fire Radio System • Operational Area Satellite Information System (OASIS) • Statewide Mutual Aid Radio System (SMARS) • State Communications (STACOM) ***Auxiliary Communications Services*** • Radio Amateur Civil Emergency Service (RACES) • Military Affiliate Radio Service (MARS) • Civil Air Patrol (CAP) • Citizens Band REACT (CBR)
Facilities and Equipment	• 530 portable radios • 510 mobile radios • 168 fixed stations and receivers • 85 mobile relays • 60 remote control units • 475 cellular telephones • 768 pagers
Equipment Age/Life Cycle	• Fixed Equipment (includes fixed stations and receivers, and mobile relays) - 86% new to 5 years of age - 14% between 6 and 10 years of age • Mobile Radios - 50% new to 5 years of age - 50% between 6 and 10 years of age • Portable Radios - 50% new to 5 years of age - 50% between 6 and 10 years of age • Cellular Telephones - 100% new to 5 years of age • Pager - 100% new to 5 years of age
Satellite Communications	• Operational Area Satellite Information System • Uplinks and downlinks at each area OES facility

GOVERNOR'S OFFICE OF EMERGENCY SERVICES

Governor's Office of Emergency Services FY 1997-1998 Budget	
Item	***Budget***
Engineering	$145,000
Unit Costs	$159,000
[1]Microwave	$628,000
[2]Technician	$165,000
[3]Other	$556,000
MSA/Strategic Plan	$19,000
[4]FY 97-98 DGS Total	***$1,672,000***
[5]Agency Reported Total (9/97)	***No Change***

[1] Includes maintenance, depreciation, and additional equipment (if any).
[2] Includes VHF installation and maintenance.
[3] Includes miscellaneous flow-through costs and CMARS.
[4] DGS Budget reflects Rate Book totals.
[5] Total reflects all Telecommunications cost items budgeted by Agency.

AGGREGATE COST MODEL

10 Agency Aggregate Costs FY 1997-1998 Budget	
Item	***Budget***
CHP	$27,067,000
CDC	$5,050,000
DFG	$1,555,000
CDF	$10,700,000
DOJ	$534,000
DPR	$3,360,000
DOT	$10,413,000
DWR	$2,014,000
CYA	$1,020,000
OES	$1,672,000
TOTAL	***$63,385,000***

Note: Reflects Agency Reported Totals and Includes Approved BCPs

STATE OF CALIFORNIA
PUBLIC SAFETY RADIO COMMUNICATIONS PROJECT

BASELINE TECHNOLOGY SUMMARY
**VOICE RADIO*

	Architecture							Access Technology			Other	
Agency	Conventional	Trunking	Signal-Analog	Signal-Digital	SSB	Satellite-LEO	Satellite-GEO	FDMA	TDMA	CDMA	CTSU	SMR
CHP	X		X		X		X				X	
CDC												
Inst.	X	X	X								X	
Parole	X		X								X	
Trans.	X		X								X	
DFG	X		X		X						X	
CDF	X		X				X				X	
DOJ	X		X								X	
DPR	X		X								X	
DOT	X	X	X					X			X	X
DWR	X		X				X				X	
CYA												
Inst.	X	X	X						X		X	
Parole	X		X								X	
Trans.	X		X								X	
OES	X		X				X				X	

Note:
CDMA- Code Division Multiple Access
CSC- Circuit Switched Cellular
CTSU- Cellular Telephone System Use
FDMA- Frequency Division Multiple Access
GEO- Geostationary Earth Orbit
LEO- Low Earth Orbit
SMR- Specialized Mobile Radio
SSB- Single-Sideband Radio
TDMA- Time Division Multiple Access

** Technology currently in place and in use by each Agency*

STATE OF CALIFORNIA
PUBLIC SAFETY RADIO COMMUNICATIONS PROJECT

BASELINE TECHNOLOGY SUMMARY
**MOBILE DATA*

	Architecture									Mobile Data User Equipment				
Agency	DMDN	IV & DN	CSC	CDPD	PPRN	ESMR	PCS	SMD	E-Paging	MSTs	MDTs	MDCs	PDDs	AVL
CHP				X		X						X		X
CDC														
Inst.														
Parole														
Trans.														
DFG														
CDF								X				X		
DOJ														
DPR														
DOT														
DWR														
CYA														
Inst.														
Parole														
Trans.														
OES								X				X		

Note:
AVL- Automatic Vehicle Location
CDPD- Cellular Digital Package Data
CSC- Circuit Switched Cellular
CTSU- Cellular Telephone System Use
DMDN- Dedicated Mobile Data Network
E-Paging- Enhanced Paging
ESMR- Enhanced Specialized Mobile Radio (RAM)
IV & DN- Integrated Voice and Data Network
MDC- Mobile Data Computer
MDT- Mobile Data Terminal
MST- Mobile Status Terminal
PCS- Personal Communication System
PDD- Portable Data Devices
PPRN- Private Packet Radio Networks
SMD- Satellite Mobile Data

** Technology currently in place and in use by each Agency*

STATE OF CALIFORNIA
PUBLIC SAFETY RADIO COMMUNICATIONS PROJECT

***BASELINE SPECTRUM SUMMARY**

	FREQUENCY BANDS						
Agency	VHF Low-Band 25-50 MHz	VHF High-Band 150-174 MHz	220 MHz Band 220-222 MHz	UHF Band 450-470 MHz	UHF-T Band 470-512 MHz	UHF Channels 60-69 746-806 MHz	800 MHz Band 806/821-824/866-869 MHz
CHP	X	X	X	X			
CDC	X	X		X			X
Inst.							
Parole							
Trans.							
DFG	X	X		X			X
CDF		X		X			X
DOJ		X		X			
DPR		X					X
DOT	X	X		X			X
DWR		X					
CYA	X	X		X			X
Inst.							
Parole							
Trans.							
OES	X	X		X			X

***Spectrum currently in place and in use by each Agency**

APPENDIX C

ALTERNATIVE 3 – AGENCY SYSTEM SHARING

THE WARNER GROUP

APPENDIX C
ALTERNATIVE 3 – AGENCY SYSTEM SHARING

TABLE OF CONTENTS

SHARED SYSTEMS COST SUMMARY

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SUMMARY COST MODEL

Alternative 3 – Shared, Hybrid Voice Radio Infrastructure (VHF High-Band and 746-806 MHz)

ONE-TIME

Voice

1. Equipment costs include antennas, feed lines, mounting hardware, brackets, programming, etc.

1(b). Calculates the number of in-building bi-directional amplifier/antenna systems required as being the number of console upgrades divided by two. Assumes one console upgrade per dispatch location, and that one out of two of these locations will require enhanced in-building coverage.

2. See Note #4 on Alternative 2 Summary & Rationale (page D-24).
3. See Note #5 on Alternative 2 Summary & Rationale (page D-24).
4. See Note #6 on Alternative 2 Summary & Rationale (page D-24).
5. See Note #7 on Alternative 2 Summary & Rationale (page D-24).
6. Provides for remote receivers to improve portable (talk-in) coverage – Accounts for only two host systems.
7. Provides upgraded interface to existing console positions (e.g. trunking or digital modes).
8. See Note #10 on Alternative 2 Summary & Rationale (page D-24).
9. Assumes that shared systems implementation would result in site development efficiencies. Statewide coverage can be supported with 1,025 sites at 700/800 MHz and 377 (plus 50 additional) at VHF High-Band. Eighty percent of required sites will undergo minor modifications.
10. See Note 9. Ten percent of required sites will undergo major upgrades.
11. See Note 9. Ten percent of required sites will be completely new sites.
12. Costs include one-time replacement of mobile radio inventories, plus new equipment to accommodate projected growth over 15 years. Assumes hi-spec radios.

12(b). See Note #12.a. Assumes moderate-spec radios.

13. Costs include one-time replacement of portable radio inventories, plus new equipment to accommodate projected growth over 15 years. Assumes hi-spec radios.

13(b). See Note #13.a. Assumes moderate-spec radios.

14. Costs include 450 fixed stations at $10,000 to $15,000 each for CDF, and 485 fixed stations at $5,000 to $7,500 for all other participating agencies.
15. Costs include 400 control stations and RCUs at $6,000 to $7,500 each for CDF, and 375 control stations and RCUs at $5,000 to $7,500 for all other participating agencies.
16. Costs include one-time replacement of existing CDF mobile relays (200). Required replacement costs for all other existing mobile relays included in Fixed Stations.
17. Costs consider replacement of workstation electronics.

Data

18. Costs include fixed site transceiver equipment for user-owned mobile data networks.
19. Costs include network controllers for user-owned mobile data network.
20. Provides point of interface and routing for host computer system.
21. Costs include Earth station links for leased satellite services. Assumes both CDF and OES will lease mobile data services.
22. Costs include computer or terminal, radio, and RF modem.
23. Costs include mobile transceivers and modems for data devices operating on leased satellite services. Costs associated with CDF and OES only.
24. Transport costs are for commercially provided mobile data infrastructure. Assumes $25 to $35 per unit per month for 12 years. Cost range includes miscellaneous taxes. Costs associated with CDF and OES only.

Recurring

25. See Note #12 on Alternative 2 Summary & Rationale (page D-24).
26. Calculation assumes that ≈71% of the new sites without microwave will be serviced by leased T-1 or better circuits provided by the telephone company. See Note #'s 10 & 11 on Alternative 2 Summary & Rationale (page D-24) for details.
27. Costs include preventative equipment maintenance, repair, parts, and service. Estimate based on current Baseline expenditures as a factor of total fixed, mobile, and portable unit inventories. High costs include 15% contingency over 15 years to accommodate unanticipated expenditures.
28. Costs include engineering, maintenance, installation, test, and replacement equipment, vault rental and depreciation. Estimates based on current Baseline expenditures. High costs include 15% contingency over 15 years to accommodate unanticipated expenditures.
29. Costs include technical design and engineering support for new, replacement, and modification of existing systems. Estimates based on current Baseline expenditures. High costs include 15% contingency over 15 years to accommodate unanticipated expenditures. Engineering costs associated with implementation of new voice and data systems included in one-time costs.
30. Costs include VHF installation and maintenance. Estimates based on current Baseline expenditures. High costs include 15% contingency over 15 years to accommodate unanticipated expenditures.
31. Costs include parts, materials, and private sector contracts. Estimates based on current Baseline expenditures. High costs include 15% contingency over 15 years to accommodate unanticipated expenditures.

Required Infrastructure Cost Estimates
Hybrid Voice/Data Radio Infrastructure (VHF High Band and UHF)

ONE TIME COSTS	*Quantity*	**Per Unit Cost Low*	**Per Unit Cost High*	*Total Costs Low*	*Total Costs High*
Voice Radio System					
Backbone (based upon 1,025 total sites)					
[1a] Fixed Site Transceiver Equipment	9,225	$ 25,000	$ 35,000	$ 230,625,000	$ 322,875,000
[1b] In-Building Bi-Directional Amp/Antenna System	159	$ 40,000	$ 50,000	$ 6,340,000	$ 7,925,000
[2] Central System Controllers	50	$ 1,000,000	$ 1,400,000	$ 50,000,000	$ 70,000,000
[3] Simulcast Controllers	13	$ 250,000	$ 300,000	$ 3,250,000	$ 3,900,000
[4] System Controller	0	$ 150,000	$ 200,000	$ -	$ -
[5] Remote Site Controllers	1,327	$ 50,000	$ 65,000	$ 66,350,000	$ 86,255,000
[6] Voting System	75	$ 15,000	$ 20,000	$ 1,125,000	$ 1,500,000
[7] Console Interfaces	317	$ 8,000	$ 10,000	$ 2,536,000	$ 3,170,000
[8] Added Microwave Paths (to 29% of new sites w/o µwave)	225	$ 250,000	$ 350,000	$ 56,187,500	$ 78,662,500
[9] Minor Site Upgrades (to 80% of total sites)	820	$ 60,000	$ 90,000	$ 49,200,000	$ 73,800,000
[10] Major Site Upgrades (to 10% of total sites)	103	$ 500,000	$ 1,000,000	$ 51,500,000	$ 103,000,000
[11] New Site Acquisition (10% of total sites)	102	$ 500,000	$ 1,000,000	$ 51,000,000	$ 102,000,000
Design and Configuration (10% of equipment)				$ 41,641,000	$ 57,429,000
Installation/Integration/Training (25% of equipment)				$ 104,103,000	$ 143,572,000
Spare Equipment/parts (3% of equipment)				$ 12,492,000	$ 17,229,000
Subtotal				**$ 726,349,500**	**$ 1,071,317,500**
User Equipment					
[12a] Mobile Radios (Hi Spec)	15,757	$ 3,100	$ 3,600	$ 48,846,700	$ 56,725,000
[13a] Portable Radios (Hi Spec)	21,980	$ 2,600	$ 3,400	$ 57,148,000	$ 74,732,000
[12b] Mobile Radios (Moderate Spec)	16,624	$ 2,400	$ 2,800	$ 39,897,600	$ 46,547,000
[13b] Portable Radios (Moderate Spec)	8,467	$ 2,000	$ 2,500	$ 16,934,000	$ 21,168,000
[14] Fixed Stations	932	$ 5,000	$ 7,500	$ 4,660,000	$ 6,990,000
[15] Control Stations/Remote Control Units	1,023	$ 5,000	$ 7,500	$ 5,115,000	$ 7,673,000
[16] Mobile Relays	200	$ 15,000	$ 17,000	$ 3,000,000	$ 3,400,000
[17] Console Upgrades	317	$ 50,000	$ 60,000	$ 15,850,000	$ 19,020,000
Installation/Integration/Training (10% of equipment)				$ 19,145,000	$ 23,626,000
Spare Equipment/Parts (3% of Eqpmt)				$ 5,744,000	$ 7,088,000
Subtotal				**$ 216,340,300**	**$ 266,969,000**
Implementation Support (2% of equipment)				$ 15,441,000	$ 22,131,000
Sales Tax (8% of equipment)				$ 76,191,000	$ 108,266,000
Contingency (15% of equipment and services)				$ 143,720,000	$ 204,063,000
Total Voice Radio System Cost				**$ 1,178,041,800**	**$ 1,672,746,500**
Data Radio System					
Backbone					
[18] Fixed Site Transceiver Equipment	1,538	$ 25,000	$ 40,000	$ 38,437,500	$ 61,500,000
[19] Network Controllers	20	$ 1,000,000	$ 1,250,000	$ 20,000,000	$ 25,000,000
[20] Message Switching	20	$ 2,000,000	$ 2,500,000	$ 40,000,000	$ 50,000,000
[21] Earth Station Links	32	$ 6,000	$ 8,000	$ 192,000	$ 256,000
Design and Configuration (10% of equipment)				$ 9,863,000	$ 13,676,000
Installation/Integration/Training (25% of equipment)				$ 24,657,000	$ 34,189,000
Spare Equipment (3% of equipment)				$ 2,959,000	$ 4,103,000
Subtotal				**$ 136,108,500**	**$ 188,724,000**
User Equipment					
[22] Mobile Data Devices	19,126	$ 5,000	$ 7,000	$ 95,630,000	$ 133,882,000
[23] Mobile Transceivers/Modems	1,100	$ 1,000	$ 3,500	$ 1,100,000	$ 3,850,000
[24] Transport Costs	0			$ 3,960,000	$ 5,544,000
Installation/Integration/Training (10% of equipment)				$ 10,069,000	$ 14,328,000
Spare Equipment (3% of equipment)				$ 2,901,900	$ 4,131,960
Subtotal				**$ 113,660,900**	**$ 161,735,960**
Implementation Support (2% of equipment)				$ 3,986,000	$ 5,601,000
Sales Tax (8% of equipment)				$ 20,300,000	$ 28,485,000
Contingency (15% of equipment and services)				$ 38,063,000	$ 53,409,000
Total Data Radio Cost				**$ 312,118,400**	**$ 437,954,960**
Total Voice and Data Radio Systems Cost				***$ 1,490,160,200***	***$ 2,110,701,460***
RECURRING SUPPORT COSTS					
[25] New lease costs (all new and 25% of existing sites)	742	$ 2,000	$ 2,500	$ 267,210,000	$ 334,012,500
[26] Added telco T-1 circuits (at 71% of new sites w/o µwave)	550	$ 500	$ 700	$ 49,522,500	$ 69,331,500
[27] Unit Costs				$ 285,645,000	$ 328,500,000
[28] Microwave Services				$ 96,000,000	$ 104,000,000
[29] Engineering				$ 205,000,000	$ 222,000,000
[30] Technician Services				$ 192,000,000	$ 206,000,000
[31] Miscellaneous Flow Through				$ 120,000,000	$ 129,000,000
Total Recurring Support Costs				**$ 1,215,377,500**	**$ 1,392,844,000**
TOTAL 15 YEAR COSTS				***$ 2,705,537,700***	***$ 3,503,545,460***

* Industry average based on best available estimates; not based on any specific vendor product line. Ranges accommodate variances in competitive pricing features.

APPENDIX D

ALTERNATIVE 2 – AGENCY INDEPENDENT INITIATIVES

THE WARNER GROUP

APPENDIX D
ALTERNATIVE 2 –AGENCY INDEPENDENT INITIATIVES

CONTENTS

SUMMARY - SYSTEMS DESCRIPTIONS AND CONFIGURATIONS

Agency	Spectrum	Voice Technology	Data Technology	Typical Coverage
CHP	746-869 MHz	Trunking	Dedicated network	Statewide, transportation routes, urban areas, access roads, etc.
CDC	746-869 MHz, VHF High Band (138-174 MHz)	Trunking	Dedicated network	Institutions & transportation routes
DFG	VHF High Band (138-174 MHz)	Conventional	Dedicated network	Statewide, transportation routes, recreational areas, etc.
CDF	VHF High Band (138-174 MHz)	Conventional & Trunking	Satellite	Primary response areas & ad-hoc coverage (wildlands, etc.)
DOJ	VHF High Band (138-174 MHz)	Conventional	Dedicated network	Statewide, mirrors CHP requirements
DPR	746-869 MHz, VHF High Band (138-174 MHz)	Conventional	Dedicated network	State parks and transportation routes
DOT	746-869 MHz	Trunking	Dedicated network	State highways, access roads, and additional areas of responsibility
DWR	VHF High Band (138-174 MHz)	Conventional	Dedicated network	State aqueduct system
CYA	746-869 MHz, VHF High Band (138-174 MHz)	Conventional & Trunking	Dedicated network	Institutions & transportation routes
OES	VHF High Band, UHF	Conventional	Satellite	Statewide, wildlands (fire), flatlands (floods), faultlines (earthquakes), etc.

CALIFORNIA HIGHWAY PATROL (CHP)

Migrate from VHF low band technology to digital, trunking technology, potentially in both the VHF high band and 764 to 869 MHz frequency ranges. The system configuration will comprise the sites necessary to ensure highly reliable (95%) communications coverage in any of CHP's service areas. The number of sites selected (1025) allows for coverage of over 80% of the State's total land mass, excluding predominantly areas which are inaccessible (mountainous terrain without improved access roads, military reserves, et cetera). This configuration assumes that nearly a third of the statewide coverage will be provided by a VHF high band infrastructure, and the remaining two-thirds of the statewide coverage will be provided by a 700/800 MHz infrastructure. This will require CHP vehicles continue to be equipped with two radios, a transition being made from the low band and high band VHF configuration to a high band and 700/800 MHz configuration. Implement a dedicated mobile data network.

Configuration

Voice

1. Includes one-time replacement of existing, fixed low band equipment. Assumes single control stations at each area office and 1,025 remote sites to meet coverage requirements in the higher frequency bands. Also assumes an average of four transceivers (includes control channel) per site to provide increased channel capacity. Costs include antennas, feed lines, mounting hardware, brackets, programming, et cetera. Also see note #'s 1, 2, & 3 on Alternative 2 Summary & Rationale (page D-24).

1(b). Calculates the number of in-building bi-directional amplifier/antenna systems required as being the number of console upgrades divided by two. Assumes one console upgrade per dispatch location, and that one out of two of these locations will require enhanced in-building coverage.

2. See Note #4 on Alternative 2 Summary & Rationale (page D-24).
3. See Note #5 on Alternative 2 Summary & Rationale (page D-24).
4. See Note #6 on Alternative 2 Summary & Rationale (page D-24).
5. See Note #7 on Alternative 2 Summary & Rationale (page D-24).
6. Comprehensive trunking coverage; no fixed site transceivers will be voted.
7. Interfaces for 24 dispatch centers averaging five positions.
8. See Note #10 on Alternative 2 Summary & Rationale (page D-24).
9. Assumes 80% of all required sites will undergo minor modifications.
10. Assumes 10% of all required sites will undergo major upgrades.
11. Assumes 10% of all required sites will be comprised of completely new sites.
12. Installation of two radios in each vehicle to accommodate both the 700/800 MHz and VHF High-Band infrastructures. Assumes 5% factor for future growth. Assumes hi-spec radios only
13. One-time replacement of existing radio inventory. Assumes 5% factor for future growth. Assumes hi-spec radios only.
14. No addition or replacement of existing fixed stations.
15. Replacement of existing fixed control points and the addition of control points to accommodate growth over 15 years.
16. Not included in cost model.
17. Replacement of workstation electronics.

Data

18. Statewide mobile data capability. Assumes an average of 1.5 channels per site.
19. Four regional network controllers with redundancy.
20. Four message switches plus backup.
21. Not included in cost model.
22. Each vehicle equipped with mobile voice radio and mobile data device; also, approximately 500 spare devices (includes computer or terminal, radio, and RF modem).
23. Not included in cost model.
24. Not included in cost model.

New Recurring Costs

25. See Note #12 on Alternative 2 Summary & Rationale (page D-24).
26. Calculation assumes that ≈71% of the new sites without microwave will be serviced by leased T-1 or better circuits provided by the telephone company. See Note #'s 10 & 11 on Alternative 2 Summary & Rationale (page D-24) for details.

Required Infrastructure Cost Estimates
California Highway Patrol

	Quantity	*Per Unit Cost Low	*Per Unit Cost High	Total Costs Low	Total Costs High
Voice Radio System					
Backbone (based upon 1,025 total sites)					
[1a] Fixed Site Transceiver Equipment	4,100	$ 25,000	$ 35,000	$ 102,500,000	$ 143,500,000
[1b] In-Building Bi-Directional Amp/Antenna Systems	60	$ 40,000	$ 50,000	$ 2,400,000	$ 3,000,000
[2] Central System Controllers	40	$ 1,000,000	$ 1,400,000	$ 40,000,000	$ 56,000,000
[3] Simulcast Controllers	9	$ 250,000	$ 300,000	$ 2,250,000	$ 2,700,000
[4] System Controller	0	$ 150,000	$ 200,000	$ -	$ -
[5] Remote Site Controllers	1,005	$ 50,000	$ 65,000	$ 50,250,000	$ 65,325,000
[6] Voting System	0	$ 15,000	$ 20,000	$ -	$ -
[7] Console Interfaces	120	$ 8,000	$ 10,000	$ 960,000	$ 1,200,000
[8] Added Microwave Paths (to 29% of new sites w/o mwave)	225	$ 250,000	$ 350,000	$ 56,250,000	$ 78,750,000
[9] Minor Site Upgrades (to 80% of total sites)	820	$ 60,000	$ 90,000	$ 49,200,000	$ 73,800,000
[10] Major Site Upgrades (to 10% of total sites)	103	$ 500,000	$ 1,000,000	$ 51,500,000	$ 103,000,000
[11] New Site Acquisition (to 10% of total sites)	102	$ 500,000	$ 1,000,000	$ 51,000,000	$ 102,000,000
Design and Configuration (10% of equipment)				$ 25,461,000	$ 35,047,500
Installation/Integration/Training (25% of equipment)				$ 63,653,000	$ 87,618,750
Spare Equipment/Parts (3% of equipment)				$ 7,638,000	$ 10,514,250
Subtotal				**$ 503,062,000**	**$ 762,456,000**
User Equipment					
[12a] Mobile Radios (Hi Spec)	8,080	$ 3,100	$ 3,600	$ 25,048,000	$ 29,088,000
[13a] Portable Radios (Hi Spec)	7,500	$ 2,600	$ 3,400	$ 19,500,000	$ 25,500,000
[12b] Mobile Radios (Moderate Spec)	0	$ 2,400	$ 2,800	$ -	$ -
[13b] Portable Radios (Moderate Spec)	0	$ 2,000	$ 2,500	$ -	$ -
[14] Fixed Stations	0	$ 5,000	$ 7,500	$ -	$ -
[15] Control Stations/Remote Control Units	160	$ 5,000	$ 7,500	$ 800,000	$ 1,200,000
[16] Mobile Relays	0	$ 15,000	$ 17,000	$ -	$ -
[17] Console Upgrades	120	$ 50,000	$ 60,000	$ 6,000,000	$ 7,200,000
Installation/Integration/Training (10% of equipment)				$ 5,134,800	$ 6,299,000
Spare Equipment/Parts (3% of Eqpmt)				$ 1,540,000	$ 1,890,000
Subtotal				**$ 58,023,000**	**$ 71,177,000**
Implementation Support (2% of equipment)				$ 9,337,000	$ 14,093,000
Sales Tax (8% of equipment)				$ 38,094,000	$ 57,501,000
Contingency (15% of equipment and services)				$ 85,563,000	$ 127,159,000
Total Voice Radio System Cost				**$ 694,079,000**	**$ 1,032,386,000**
Data Radio System					
Backbone					
[18] Fixed Site Transceiver Equipment	1,538	$ 25,000	$ 40,000	$ 38,438,000	$ 61,500,000
[19] Network Controllers	8	$ 1,000,000	$ 1,250,000	$ 8,000,000	$ 10,000,000
[20] Message Switching	8	$ 2,000,000	$ 2,500,000	$ 16,000,000	$ 20,000,000
[21] Earth Station Links	0	$ 6,000	$ 8,000	$ -	$ -
Design and Configuration (10% of equipment)				$ 6,243,800	$ 9,150,000
Installation/Integration/Training (25% of equipment)				$ 15,609,500	$ 22,875,000
Spare Equipment (3% of equipment)				$ 1,873,140	$ 2,745,000
Subtotal				**$ 86,164,000**	**$ 126,270,000**
User Equipment					
[22] Mobile Data Devices	4,540	$ 5,000	$ 7,000	$ 22,700,000	$ 31,780,000
[23] Mobile Transceivers/Modems	0	$ 1,000	$ 3,500	$ -	$ -
[24] Transport Costs	0			$ -	$ -
Installation/Integration/Training (10% of equipment)				$ 2,270,000	$ 3,178,000
Spare Equipment (3% of equipment)				$ 681,000	$ 953,400
Subtotal				**$ 25,651,000**	**$ 35,911,000**
Implementation Support (2% of equipment)				$ 1,754,000	$ 2,540,000
Sales Tax (8% of equipment)				$ 7,156,000	$ 10,361,000
Contingency (15% of equipment and services)				$ 17,035,000	$ 24,708,000
Total Data Radio Cost				**$ 137,760,000**	**$ 199,790,000**
Total Voice and Data Radio Systems Cost				**$ 831,839,000**	**$ 1,232,176,000**
New Recurring Support Costs					
[25] New lease costs (all new and 25% of existing sites)	742	$ 2,000	$ 2,500	$ 267,210,000	$ 334,012,500
[26] Added telco T-1 circuits (at 71% of new sites w/o mwave)	550	$ 500	$ 700	$ 49,500,000	$ 69,300,000
Adjusted Voice and Data Radio System Cost				**$ 1,148,549,000**	**$ 1,635,489,000**

***** Industry average based on best available estimates; not based on any specific vendor product line. Ranges accommodate variances in competitive pricing features.

DEPARTMENT OF CORRECTIONS

Continue implementation of 800 MHz, trunked and conventional radio systems for Transportation and Institutions and maintain VHF high band capability for Paroles and Camps based on regional system infrastructures. The system configuration reflects coverage on major transportation routes and in the immediate area surrounding correctional facilities. The configuration meeting Department unique coverage requirements will comprise 338 sites (approximately 33% of the total anticipated number of VHF high band and 700/800 MHz sites required to meet amalgamated agency statewide coverage requirements. Furnish Transportation Unit vehicles with both VHF high band and 700/800 MHz radios. Migrate to digital equipment as the existing analog equipment reaches the end of its useful life. Implement a dedicated mobile data network.

Configuration

Voice

1. Replacement of existing base stations and fixed receivers. Additional units to improve coverage for transportation with average of 2.4 voice channels per site, including the control channel. Also see note #'s 1, 2, & 3 on Alternative 2 Summary & Rationale (page D-24).

1(b). Calculates the number of in-building bi-directional amplifier/antenna systems required as being the number of console upgrades divided by two. Assumes one console upgrade per dispatch location, and that one out of two of these locations will require enhanced in-building coverage.

2. See Note #4 on Alternative 2 Summary & Rationale (page D-24).
3. See Note #5 on Alternative 2 Summary & Rationale (page D-24).
4. Single system controller at existing standalone and co-located sites and any new sites (25 existing + 7 new)
5. Remote site controller for each non-institution based site (338 total sites – 32 institutions).
6. All trunking, no fixed site voting equipment.
7. Interfaces at all institutions (33 + 7), and one in each of four regions for Parole (4), LELIU (3), OIA (3), and Transportation (3).
8. See Note #10 on Alternative 2 Summary & Rationale (page D-24).
9. Assumes 90% of all required sites will undergo minor modifications.
10. Not included in cost model.
11. Assumes 10% of all required sites will be completely new sites.
12. Replacement of existing radio inventory and addition of new equipment to accommodate growth over 15 years. (Camps and Transportation vehicles require dual radio – single control head configurations.)

12.b One-time replacement of existing inventory, plus growth projections (Institutions only).

13. One-time replacement of existing radio inventory and new equipment (i.e. parole, camps, transportation) to accommodate growth over 15 years. (LELIU, OIA)

13.b One-time replacement of existing inventory, plus growth projections (Parole, LELIU, OIA, Camps, Transportation).

14. Replacement of existing fixed stations, plus projections for future growth.
15. Replacement of existing control/remote control units (130), and projected new prison growth (28) and program expansion (Camps 39, Parole 158, LELIU 3, OIA 3, Transportation 3)
16. Not included in cost model.
17. Replacement of workstation electronics.

Data

18. Establishment of statewide mobile data capability.
19. Two network controllers with redundancy.
20. Two centralized message switches and backup.
21. Not included in cost model.
22. Includes computer or terminal, radio, and RF modem (unit counts provide for future Parole, LELIU, and Transportation users).
23. Not included in cost model.
24. Not included in cost model.

New Recurring Costs

25. See Note #12 on Alternative 2 Summary & Rationale (page D-24).
26. Calculation assumes that ≈71% of the new sites without microwave will be serviced by leased T-1 or better circuits provided by the telephone company. See Note #'s 10 & 11 on Alternative 2 Summary & Rationale (page D-24) for details.

Required Infrastructure Cost Estimates
Department of Corrections

	Quantity	*Per Unit Cost Low	*Per Unit Cost High	Total Costs Low	Total Costs High
Voice Radio System**					
Backbone (based upon 338 total sites)					
[1a] Fixed Site Transceiver Equipment	805	$ 25,000	$ 35,000	$ 20,125,000	$ 28,175,000
[1b] In-Building Bi-Directional Amp/Antenna Systems	27	$ 40,000	$ 50,000	$ 1,060,000	$ 1,325,000
[2] Central System Controllers	14	$ 1,000,000	$ 1,400,000	$ 14,000,000	$ 19,600,000
[3] Simulcast Controllers	0	$ 250,000	$ 300,000	$ -	$ -
[4] System Controller	32	$ 150,000	$ 200,000	$ 4,800,000	$ 6,400,000
[5] Remote Site Controllers	308	$ 50,000	$ 65,000	$ 15,400,000	$ 20,020,000
[6] Voting System	0	$ 15,000	$ 20,000	$ -	$ -
[7] Console Interfaces	53	$ 8,000	$ 10,000	$ 424,000	$ 530,000
[8] Added Microwave Paths (to 29% of new sites w/o mwave)	26	$ 250,000	$ 350,000	$ 6,500,000	$ 9,100,000
[9] Minor Site Upgrades (to 80% of total sites)	271	$ 60,000	$ 90,000	$ 16,260,000	$ 24,390,000
[10] Major Site Upgrades (to 10% of total sites) CDC-None	0	$ 500,000	$ 1,000,000	$ -	$ -
[11] New Site Acquisition (to 10% of total sites)	30	$ 500,000	$ 1,000,000	$ 15,000,000	$ 30,000,000
Design and Configuration (10% of equipment)				$ 6,230,900	$ 8,515,000
Installation/Integration/Training (25% of equipment)				$ 15,577,000	$ 21,287,500
Spare Equipment/Parts (3% of equipment)				$ 1,869,000	$ 2,554,500
Subtotal				**$ 117,246,000**	**$ 171,897,000**
User Equipment					
[12a] Mobile Radios (Hi Spec)	1,263	$ 3,100	$ 3,600	$ 3,915,000	$ 4,547,000
[13a] Portable Radios (Hi Spec)	7,911	$ 2,600	$ 3,400	$ 20,569,000	$ 26,897,000
[12b] Mobile Radios (Moderate Spec)	222	$ 2,400	$ 2,800	$ 533,000	$ 622,000
[13b] Portable Radios (Moderate Spec)	2,261	$ 2,000	$ 2,500	$ 4,522,000	$ 5,653,000
[14] Fixed Stations	212	$ 5,000	$ 7,500	$ 1,060,000	$ 1,590,000
[15] Control Stations/Remote Control Units	364	$ 5,000	$ 7,500	$ 1,820,000	$ 2,730,000
[16] Mobile Relays	0	$ 15,000	$ 17,000	$ -	$ -
[17] Console Upgrades	53	$ 50,000	$ 60,000	$ 2,650,000	$ 3,180,000
Installation/Integration/Training (10% of equipment)				$ 3,506,900	$ 4,522,000
Spare Equipment/Parts (3% of Eqpmt)				$ 1,052,000	$ 1,357,000
Subtotal				**$ 39,628,000**	**$ 51,098,000**
Implementation Support (2% of equipment)				$ 2,631,000	$ 3,773,000
Sales Tax (8% of equipment and services)				$ 10,735,000	$ 15,395,000
Contingency (15% of equipment and services)				$ 23,926,000	$ 34,015,000
Total Voice Radio System Cost				**$ 194,166,000**	**$ 276,178,000**
Data Radio System					
Backbone					
[18] Fixed Site Transceiver Equipment	338	$ 25,000	$ 40,000	$ 8,456,000	$ 13,530,000
[19] Network Controllers	4	$ 1,000,000	$ 1,250,000	$ 4,000,000	$ 5,000,000
[20] Message Switching	4	$ 2,000,000	$ 2,500,000	$ 8,000,000	$ 10,000,000
[21] Earth Station Links	0	$ 6,000	$ 8,000	$ -	$ -
Design and Configuration (10% of equipment)				$ 2,045,600	$ 2,853,000
Installation/Integration/Training (25% of equipment)				$ 5,114,000	$ 7,132,500
Spare Equipment (3% of equipment)				$ 613,680	$ 855,900
Subtotal				**$ 28,229,000**	**$ 39,371,000**
User Equipment					
[22] Mobile Data Devices	1,859	$ 5,000	$ 7,000	$ 9,295,000	$ 13,013,000
[23] Mobile Transceivers/Modems	0	$ 1,000	$ 3,500	$ -	$ -
[24] Transport Costs	0			$ -	$ -
Installation/Integration/Training (10% of equipment)				$ 930,000	$ 1,301,000
Spare Equipment (3% of equipment)				$ 278,850	$ 390,390
Subtotal				**$ 10,504,000**	**$ 14,704,000**
Implementation Support (2% of equipment)				$ 613,000	$ 856,000
Sales Tax (8% of equipment and services)				$ 2,501,000	$ 3,492,000
Contingency (15% of equipment and services)				$ 5,902,000	$ 8,240,000
Total Data Radio Cost				**$ 47,749,000**	**$ 66,663,000**
Total Voice and Data Radio Systems Cost				**$ 241,915,000**	**$ 342,841,000**
New Recurring Support Costs					
[25] New lease costs (all new and 25% of existing sites)	56	$ 2,000	$ 2,500	$ 19,980,000	$ 24,975,000
[26] Added telco T-1 circuits (at 71% of new sites w/o mwave)	62	$ 500	$ 700	$ 5,602,500	$ 7,843,500
Adjusted Voice and Data Radio System Cost				**$ 267,498,000**	**$ 375,660,000**

* Industry average based on best available estimates; not based on any specific vendor product line. Ranges accommodate variances in competitive pricing features.

** Does not include costs included in construction budgets associated with new facilities. The CDC Facilities Master Plan (1996-2001) identifies the need for at least 17 new prisons during this timeframe. Radio implementation is estimated at $1.2 million per facility.

DEPARTMENT OF FISH AND GAME

Upgrade VHF high band equipment with modern conventional technology in same frequency band. The system configuration meeting Department unique coverage requirements will comprise 363 sites (approximately 85% of the total anticipated number of VHF high band sites required to meet amalgamated agency statewide coverage requirements). Implement dedicated mobile data network.

Configuration

Voice

1. One time replacement of existing fixed stations and addition of equipment at sites needed to provide improved coverage. Assumes 363 total sites and three channels per site. Also see note #'s 1, 2, & 3 on Alternative 2 Summary & Rationale (page D-24).

1(b). Calculates the number of in-building bi-directional amplifier/antenna systems required as being the number of console upgrades divided by two. Assumes one console upgrade per dispatch location, and that one out of two of these locations will require enhanced in-building coverage.

2. See Note #4 on Alternative 2 Summary & Rationale (page D-24).
3. See Note #5 on Alternative 2 Summary & Rationale (page D-24).
4. See Note #6 on Alternative 2 Summary & Rationale (page D-24).
5. See Note #7 on Alternative 2 Summary & Rationale (page D-24).
6. Total number of voting systems reflects required interfaces with dispatching locations.
7. Upgrades to consoles at existing dispatch centers.
8. See Note #10 on Alternative 2 Summary & Rationale (page D-24).
9. Assumes 80% of all required sites will undergo minor modifications.
10. Assumes 10% of all required sites will undergo major upgrades.
11. Assumes 10% of all required sites will be completely new sites.
12. Replacement of existing radio inventory. Assumes hi-spec radios for sworn users.

12(b). Replacement of existing radio inventory. Assumes moderate-spec radios for non-sworn users.

13. Replacement of existing radio inventory. Assumes hi-spec radios for sworn users.

13(b). Replacement of existing radio inventory. Assumes moderate-spec radios for non-sworn users.

14. No addition or replacement of fixed stations.
15. Replacement of fixed control points in Redding, Long Beach, Fresno, Yountville, and other remote dispatch locations.
16. No mobile relays included in cost model.
17. Console upgrades to eight consoles (includes workstation electronics).

Data

18. Assumes average of 1 channel per site.
19. Single network controller with redundancy.
20. Message switch and redundancy.
21. Not included in cost model.
22. Equips existing vehicles and boats, plus additional units to accommodate growth (includes computer or terminal, radio and RF modem).
23. Not included in cost model.
24. Not included in cost model.

New Recurring Costs

25. See Note #12 on Alternative 2 Summary & Rationale (page D-24).
26. Calculation assumes that ≈71% of the new sites without microwave will be serviced by leased T-1 or better circuits provided by the telephone company. See Note #'s 10 & 11 on Alternative 2 Summary & Rationale (page D-24) for details.

Required Infrastructure Cost Estimates
Department of Fish and Game

		**Per Unit Cost*		*Total Costs*	
	Quantity	***Low***	***High***	***Low***	***High***
Voice Radio System					
Backbone (based upon 363 total sites)					
[1a] Fixed Site Transceiver Equipment	1,089	$ 25,000	$ 35,000	$ 27,221,000	$ 38,109,750
[1b] In-Building Bi-Directional Amp/Antenna Systems	4	$ 40,000	$ 50,000	$ 160,000	$ 200,000
[2] Central System Controllers	0	$ 1,000,000	$ 1,400,000	$ -	$ -
[3] Simulcast Controllers	4	$ 250,000	$ 300,000	$ 1,000,000	$ 1,200,000
[4] System Controller	0	$ 150,000	$ 200,000	$ -	$ -
[5] Remote Site Controllers	0	$ 50,000	$ 65,000	$ -	$ -
[6] Voting System	8	$ 15,000	$ 20,000	$ 120,000	$ 160,000
[7] Console Interfaces	8	$ 8,000	$ 10,000	$ 64,000	$ 80,000
[8] Added Microwave Paths (to 29% of new sites w/o mwave)	33	$ 250,000	$ 350,000	$ 8,250,000	$ 11,550,000
[9] Minor Site Upgrades (to 80% of total sites)	291	$ 60,000	$ 90,000	$ 17,460,000	$ 26,190,000
[10] Major Site Upgrades (to 10% of total sites)	37	$ 500,000	$ 1,000,000	$ 18,500,000	$ 37,000,000
[11] New Site Acquisition (to 10% of total sites)	35	$ 500,000	$ 1,000,000	$ 17,475,000	$ 34,950,000
Design and Configuration (10% of equipment)				$ 3,681,500	$ 5,129,975
Installation/Integration/Training (25% of equipment)				$ 9,204,000	$ 12,824,938
Spare Equipment/Parts (3% of equipment)				$ 1,104,000	$ 1,538,993
Subtotal				**$ 104,240,000**	**$ 168,934,000**
User Equipment					
[12a] Mobile Radios (Hi Spec)	500	$ 3,100	$ 3,600	$ 1,550,000	$ 1,800,000
[13a] Portable Radios (Hi Spec)	500	$ 2,600	$ 3,400	$ 1,300,000	$ 1,700,000
[12b] Mobile Radios (Moderate Spec)	360	$ 2,400	$ 2,800	$ 864,000	$ 1,008,000
[13b] Portable Radios (Moderate Spec)	364	$ 2,000	$ 2,500	$ 728,000	$ 910,000
[14] Fixed Stations	0	$ 5,000	$ 7,500	$ -	$ -
[15] Control Stations/Remote Control Units	46	$ 5,000	$ 7,500	$ 230,000	$ 345,000
[16] Mobile Relays	0	$ 15,000	$ 17,000	$ -	$ -
[17] Console Upgrades	8	$ 50,000	$ 60,000	$ 400,000	$ 480,000
Installation/Integration/Training (10% of equipment)				$ 507,200	$ 624,000
Spare Equipment/Parts (3% of Eqpmt)				$ 152,000	$ 187,000
Subtotal				**$ 5,731,000**	**$ 7,054,000**
Implementation Support (2% of equipment)				$ 1,932,000	$ 3,148,000
Sales Tax (8% of equipment and services)				$ 7,881,000	$ 12,845,000
Contingency (15% of equipment and services)				$ 16,785,000	$ 26,870,000
Total Voice Radio System Cost				**$ 136,569,000**	**$ 218,851,000**
Data Radio System					
Backbone					
[18] Fixed Site Transceiver Equipment	363	$ 25,000	$ 40,000	$ 9,074,000	$ 14,518,000
[19] Network Controllers	2	$ 1,000,000	$ 1,250,000	$ 2,000,000	$ 2,500,000
[20] Message Switching	2	$ 2,000,000	$ 2,500,000	$ 4,000,000	$ 5,000,000
[21] Earth Station Links	0	$ 6,000	$ 8,000	$ -	$ -
Design and Configuration (10% of equipment)				$ 1,507,400	$ 2,201,800
Installation/Integration/Training (25% of equipment)				$ 3,768,500	$ 5,504,500
Spare Equipment (3% of equipment)				$ 452,220	$ 660,540
Subtotal				**$ 20,802,000**	**$ 30,385,000**
User Equipment					
[22] Mobile Data Devices	400	$ 5,000	$ 7,000	$ 2,000,000	$ 2,800,000
[23] Mobile Transceivers/Modems	0	$ 1,000	$ 3,500	$ -	$ -
[24] Transport Costs				$ -	$ -
Installation/Integration/Training (10% of equipment)				$ 200,000	$ 280,000
Spare Equipment (3% of equipment)				$ 60,000	$ 84,000
Subtotal				**$ 2,260,000**	**$ 3,164,000**
Implementation Support (2% of equipment)				$ 352,000	$ 511,000
Sales Tax (8% of equipment and services)				$ 1,435,000	$ 2,086,000
Contingency (15% of equipment and services)				$ 3,512,000	$ 5,109,000
Total Data Radio Cost				**$ 28,361,000**	**$ 41,255,000**
Total Voice and Data Radio Systems Cost				**$ 164,930,000**	**$ 260,106,000**
New Recurring Support Costs					
[25] New lease costs (all new and 25% of existing sites)	80	$ 2,000	$ 2,500	$ 28,872,000	$ 36,090,000
[26] Added telco T-1 circuits (at 71% of new sites w/o mwave)	80	$ 500	$ 700	$ 7,195,500	$ 10,073,700
Adjusted Voice and Data Radio System Cost				**$ 200,998,000**	**$ 306,270,000**

***** Industry average based on best available estimates; not based on any specific vendor product line. Ranges accommodate variances in competitive pricing features.

DEPARTMENT OF FORESTRY AND FIRE PROTECTION

Upgrade existing VHF high band voice radio network and migrate to trunking technology. System configuration meeting Department unique coverage requirements will comprise 377 sites (approximately 88% of the total anticipated number of VHF high band sites required to meet amalgamated agency statewide coverage requirements). Additional Department unique coverage requirements will be supported by mobile command centers and/or repeater sites. Implement and integrate to the degree practicable satellite mobile data and dedicated mobile data networks.

Configuration

Voice

1. On time replacement of existing base stations and repeaters. Assumes three channels per site at 377 total sites. Also see note #'s 1, 2, & 3 on Alternative 2 Summary & Rationale (page D-24).

1(b). Calculates the number of in-building bi-directional amplifier/antenna systems required as being the number of console upgrades divided by two. Assumes one console upgrade per dispatch location, and that one out of two of these locations will require enhanced in-building coverage.

2. See Note #4 on Alternative 2 Summary & Rationale (page D-24).
3. See Note #5 on Alternative 2 Summary & Rationale (page D-24).
4. See Note #6 on Alternative 2 Summary & Rationale (page D-24).
5. See Note #7 on Alternative 2 Summary & Rationale (page D-24).
6. Five voting sites for each of 15 command centers.
7. Interfaces at 12 existing, and any new, dispatch centers.
8. See Note #10 on Alternative 2 Summary & Rationale (page D-24).
9. Assumes 80% of all required sites will undergo minor modifications.
10. Assumes 10% of all required sites will undergo major upgrades.
11. Assumes 10% of all required sites will be completely new sites.
12. One time replacement of existing mobile radio inventory. Assumes 15% factor for future growth. Assumes all hi-spec radios.
13. One time replacement of existing portable radio inventory. Assumes 15% factor for future growth. Assumes all hi-spec radios.
14. One time replacement of existing fixed stations.
15. One time replacement of existing remote control units. Assumes 15% factor for future growth.
16. One time replacement of existing mobile relays.
17. Console equipment upgrades to accommodate long-term requirements.

Data

18. Assumes average of 1 channel per site.
19. Single network controller with redundancy.
20. One centralized message switch plus backup.
21. Leased satellite service. One earth station link for 21 9-1-1 Emergency Command Centers, five mobile command centers, and three 9-1-1 centers.
22. Equips 100 aircraft, 300 fire vehicles, 400 chief officer vehicles, and four crew vehicles at each of 41 camps. Assumes 15% factor for future growth.
23. One mobile transmitter per mobile data device (see note #22).
24. Transport costs are for commercially provided mobile data infrastructure ($25 to $35 per unit per month for 12 years plus miscellaneous taxes).

New Recurring Costs

25. See Note #12 on Alternative 2 Summary & Rationale (page D-24).
26. Calculation assumes that ≈71% of the new sites without microwave will be serviced by leased T-1 or better circuits provided by the telephone company. See Note #'s 10 & 11 on Alternative 2 Summary & Rationale (page D-24) for details.

Required Infrastructure Cost Estimates
Department of Forestry and Fire Protection

	Quantity	*Per Unit Cost Low	*Per Unit Cost High	Total Costs Low	Total Costs High
Voice Radio System**					
Backbone (based upon 427 total sites)					
[1a] Fixed Site Transceiver Equipment	1,281	$ 25,000	$ 35,000	$ 32,025,000	$ 44,835,000
[1b] In-Building Bi-Directional Amp/Antenna Systems	8	$ 40,000	$ 50,000	$ 320,000	$ 400,000
[2] Central System Controllers	18	$ 1,000,000	$ 1,400,000	$ 18,000,000	$ 25,200,000
[3] Simulcast Controllers	4	$ 250,000	$ 300,000	$ 1,000,000	$ 1,200,000
[4] System Controller	0	$ 150,000	$ 200,000	$ -	$ -
[5] Remote Site Controllers	418	$ 50,000	$ 65,000	$ 20,900,000	$ 27,170,000
[6] Voting System	75	$ 15,000	$ 20,000	$ 1,125,000	$ 1,500,000
[7] Console Interfaces	16	$ 8,000	$ 10,000	$ 128,000	$ 160,000
[8] Added Microwave Paths (to 29% of new sites w/o mwave)	52	$ 250,000	$ 350,000	$ 13,000,000	$ 18,200,000
[9] Minor Site Upgrades (to 80% of total sites)	342	$ 60,000	$ 90,000	$ 20,520,000	$ 30,780,000
[10] Major Site Upgrades (to 10% of total sites)	43	$ 500,000	$ 1,000,000	$ 21,500,000	$ 43,000,000
[11] New Site Acquisition (to 10% of total sites)	42	$ 500,000	$ 1,000,000	$ 21,000,000	$ 42,000,000
Design and Configuration (10% of equipment)				$ 8,649,800	$ 11,866,500
Installation/Integration/Training (25% of equipment)				$ 21,625,000	$ 29,666,250
Spare Equipment/Parts (3% of equipment)				$ 2,595,000	$ 3,559,950
Subtotal				**$ 182,388,000**	**$ 279,538,000**
User Equipment					
[12a] Mobile Radios (Hi Spec)	2,320	$ 3,100	$ 3,600	$ 7,192,000	$ 8,352,000
[13a] Portable Radios (Hi Spec)	2,820	$ 2,600	$ 3,400	$ 7,332,000	$ 9,588,000
[12b] Mobile Radios (Moderate Spec)	0	$ 2,400	$ 2,800	$ -	$ -
[13b] Portable Radios (Moderate Spec)	0	$ 2,000	$ 2,500	$ -	$ -
[14] Fixed Stations	450	$ 5,000	$ 7,500	$ 2,250,000	$ 3,375,000
[15] Control Stations/Remote Control Units	400	$ 5,000	$ 7,500	$ 2,000,000	$ 3,000,000
[16] Mobile Relays	200	$ 15,000	$ 17,000	$ 3,000,000	$ 3,400,000
[17] Console Upgrades	16	$ 50,000	$ 60,000	$ 800,000	$ 960,000
Installation/Integration/Training (10% of equipment)				$ 2,257,400	$ 2,868,000
Spare Equipment/Parts (3% of Eqpmt)				$ 677,000	$ 860,000
Subtotal				**$ 25,508,000**	**$ 32,403,000**
Implementation Support (2% of equipment)				$ 3,507,000	$ 5,351,000
Sales Tax (8% of equipment and services)				$ 14,310,000	$ 21,831,000
Contingency (15% of equipment and services)				$ 31,710,000	$ 47,594,000
Total Voice Radio System Cost				**$ 257,423,000**	**$ 386,717,000**
Data Radio System					
Backbone					
[18] Fixed Site Transceiver Equipment	338	$ 25,000	$ 40,000	$ 8,456,000	$ 13,530,000
[19] Network Controllers	2	$ 1,000,000	$ 1,250,000	$ 2,000,000	$ 2,500,000
[20] Message Switching	2	$ 2,000,000	$ 2,500,000	$ 4,000,000	$ 5,000,000
[21] Earth Station Links	29	$ 6,000	$ 8,000	$ 174,000	$ 232,000
Design and Configuration (10% of equipment)				$ 1,463,000	$ 2,126,200
Installation/Integration/Training (25% of equipment)				$ 3,657,500	$ 5,315,500
Spare Equipment (3% of equipment)				$ 438,900	$ 637,860
Subtotal				**$ 20,189,000**	**$ 29,342,000**
User Equipment					
[22] Mobile Data Devices	1,100	$ 5,000	$ 7,000	$ 5,500,000	$ 7,700,000
[23] Mobile Transceivers/Modems	1,100	$ 1,000	$ 3,500	$ 1,100,000	$ 3,850,000
[24] Transport Costs				$ 3,960,000	$ 5,544,000
Installation/Integration/Training (10% of equipment)				$ 1,056,000	$ 1,709,000
Spare Equipment (3% of equipment)				$ 198,000	$ 346,500
Subtotal				**$ 11,814,000**	**$ 19,150,000**
Implementation Support (2% of equipment)				$ 517,000	$ 787,000
Sales Tax (8% of equipment and services)				$ 2,107,000	$ 3,210,000
Contingency (15% of equipment and services)				$ 4,878,000	$ 7,392,000
Total Data Radio Cost				**$ 39,505,000**	**$ 59,881,000**
Total Voice and Data Radio Systems Cost				**$ 296,928,000**	**$ 446,598,000**
New Recurring Support Costs					
[25] New lease costs (all new and 25% of existing sites)	144	$ 2,000	$ 2,500	$ 51,930,000	$ 64,912,500
[26] Added telco T-1 circuits (at 71% of new sites w/o mwave)	125	$ 500	$ 700	$ 11,250,000	$ 15,750,000
Adjusted Voice and Data Radio System Cost				**$ 360,108,000**	**$ 527,261,000**

* Industry average based on best available estimates; not based on any specific vendor product line. Ranges accommodate variances in competitive pricing features.

** Assumes implementation of trunking technology in select areas of the State. This assumption is currently being assessed. Alternate technologies may be utilized.

DEPARTMENT OF JUSTICE

Upgrade VHF high band equipment with modern conventional technology in same frequency band. Furnish DOJ vehicles with two radios, one VHF high band and the other capable of communications with the prevailing CHP network. The system configuration meeting Department unique coverage requirements will comprise 179 sites (approximately 42% of the total anticipated number of VHF high band sites required to meet amalgamated agency statewide coverage requirements. Implement dedicated mobile data network.

Configuration

Voice

1. One time replacement of existing fixed stations and addition of equipment at sites needed to provide improved coverage. Assumes three channels per site at 179 total sites. Also see note #'s 1, 2, & 3 on Alternative 2 Summary & Rationale (page D-24).

1(b). Calculates the number of in-building bi-directional amplifier/antenna systems required as being the number of console upgrades divided by two. Assumes one console upgrade per dispatch location, and that one out of two of these locations will require enhanced in-building coverage.

2. See Note #4 on Alternative 2 Summary & Rationale (page D-24).
3. See Note #5 on Alternative 2 Summary & Rationale (page D-24).
4. See Note #6 on Alternative 2 Summary & Rationale (page D-24).
5. See Note #7 on Alternative 2 Summary & Rationale (page D-24).
6. Total number of voting systems reflects required interfaces with dispatching locations.
7. Console interfaces in San Francisco (3), Fresno (1), Los Angeles (2), San Diego (1), Sacramento (2), and selected CHP dispatch centers (13).
8. See Note #10 on Alternative 2 Summary & Rationale (page D-24).
9. Assumes 80% of all required sites will undergo minor modifications.
10. Assumes 10% of all required sites will undergo major upgrades.
11. Assumes 10% of all required sites will be completely new sites.
12. Installation of two radios to accommodate both the 700/800 MHz and VHF High-Band infrastructures (includes 5% factor for future growth). Radios assumed to be highest tier, public safety grade equipment.
13. One-time replacement of existing radio inventory (includes 5% factor for future growth). Radios assumed to be highest tier, public safety grade equipment.
14. No addition or replacement of fixed stations.
15. No addition or replacement of control stations and RCUs.
16. No addition or replacement of mobile relays.
17. Console upgrades to consoles identified above (includes workstation electronics).

Data

18. Assumes average of 1 channel per site.
19. Single network controller with redundancy.
20. One centralized message switch plus backup.
21. Not included in cost model.
22. Twenty-five percent of vehicles equipped with a mobile voice radio will also be equipped with mobile data (includes computer or terminal, radio, and RF modem).
23. Not included in cost model.
24. Not included in cost model.

New Recurring Costs

25. See Note #12 on Alternative 2 Summary & Rationale (page D-24).
26. Calculation assumes that ≈71% of the new sites without microwave will be serviced by leased T-1 or better circuits provided by the telephone company. See Note #'s 10 & 11 on Alternative 2 Summary & Rationale (page D-24) for details.

Required Infrastructure Cost Estimates
Department of Justice

		**Per Unit Cost*		*Total Costs*	
	Quantity	***Low***	***High***	***Low***	***High***
Voice Radio System					
Backbone (based upon 179 total sites)					
[1a] Fixed Site Transceiver Equipment	538	$ 25,000 - $ 35,000		$ 13,451,000 - $	18,830,700
[1b] In-Building Bi-Directional Amp/Antenna Systems	11	$ 40,000 - $ 50,000		$ 440,000 - $	550,000
[2] Central System Controllers	0	$ 1,000,000 - $ 1,400,000		$ - - $	-
[3] Simulcast Controllers	0	$ 250,000 - $ 300,000		$ - - $	-
[4] System Controller	0	$ 150,000 - $ 200,000		$ - - $	-
[5] Remote Site Controllers	0	$ 50,000 - $ 65,000		$ - - $	-
[6] Voting System	22	$ 15,000 - $ 20,000		$ 330,000 - $	440,000
[7] Console Interfaces	22	$ 8,000 - $ 10,000		$ 176,000 - $	220,000
[8] Added Microwave Paths (to 29% of new sites w/o mwave)	0	$ 250,000 - $ 350,000		$ - - $	-
[9] Minor Site Upgrades (to 80% of total sites)	144	$ 60,000 - $ 90,000		$ 8,640,000 - $	12,960,000
[10] Major Site Upgrades (to 10% of total sites)	18	$ 500,000 - $ 1,000,000		$ 9,000,000 - $	18,000,000
[11] New Site Acquisition (to 10% of total sites)	17	$ 500,000 - $ 1,000,000		$ 8,670,000 - $	17,340,000
Design and Configuration (10% of equipment)				$ 1,439,700 - $	2,004,070
Installation/Integration/Training (25% of equipment)				$ 3,599,000 - $	5,010,175
Spare Equipment/Parts (3% of equipment)				$ 432,000 - $	601,221
Subtotal				**$ 46,178,000 - $**	**75,956,000**
User Equipment					
[12a] Mobile Radios (Hi Spec)	2,354	$ 3,100 - $ 3,600		$ 7,297,000 - $	8,474,000
[13a] Portable Radios (Hi Spec)	1,029	$ 2,600 - $ 3,400		$ 2,675,000 - $	3,499,000
[12b] Mobile Radios (Moderate Spec)		$ 2,400 - $ 2,800		$ - - $	-
[13b] Portable Radios (Moderate Spec)		$ 2,000 - $ 2,500		$ - - $	-
[14] Fixed Stations	0	$ 5,000 - $ 7,500		$ - - $	-
[15] Control Stations/Remote Control Units	0	$ 5,000 - $ 7,500		$ - - $	-
[16] Mobile Relays	0	$ 15,000 - $ 17,000		$ - - $	-
[17] Console Upgrades	22	$ 50,000 - $ 60,000		$ 1,100,000 - $	1,320,000
Installation/Integration/Training (10% of equipment)				$ 1,107,200 - $	1,329,000
Spare Equipment/Parts (3% of Eqpmt)				$ 332,000 - $	399,000
Subtotal				**$ 12,511,000 - $**	**15,021,000**
Implementation Support (2% of equipment)				$ 1,051,000 - $	1,653,000
Sales Tax (8% of equipment and services)				$ 4,288,000 - $	6,743,000
Contingency (15% of equipment and services)				$ 8,961,000 - $	13,895,000
Total Voice Radio System Cost				**$ 72,989,000 - $**	**113,268,000**
Data Radio System					
Backbone					
[18] Fixed Site Transceiver Equipment	179	$ 25,000 - $ 40,000		$ 4,484,000 - $	7,174,000
[19] Network Controllers	2	$ 1,000,000 - $ 1,250,000		$ 2,000,000 - $	2,500,000
[20] Message Switching	2	$ 2,000,000 - $ 2,500,000		$ 4,000,000 - $	5,000,000
[21] Earth Station Links	0	$ 6,000 - $ 8,000		$ - - $	-
Design and Configuration (10% of equipment)				$ 1,048,400 - $	1,467,400
Installation/Integration/Training (25% of equipment)				$ 2,621,000 - $	3,668,500
Spare Equipment (3% of equipment)				$ 314,520 - $	440,220
Subtotal				**$ 14,468,000 - $**	**20,250,000**
User Equipment					
[22] Mobile Data Devices	295	$ 5,000 - $ 7,000		$ 1,475,000 - $	2,065,000
[23] Mobile Transceivers/Modems	0	$ 1,000 - $ 3,500		$ - - $	-
[24] Transport Costs				$ - - $	-
Installation/Integration/Training (10% of equipment)				$ 148,000 - $	207,000
Spare Equipment (3% of equipment)				$ 44,250 - $	61,950
Subtotal				**$ 1,667,000 - $**	**2,334,000**
Implementation Support (2% of equipment)				$ 246,000 - $	345,000
Sales Tax (8% of equipment and services)				$ 1,005,000 - $	1,407,000
Contingency (15% of equipment and services)				$ 2,457,000 - $	3,439,000
Total Data Radio Cost				**$ 19,843,000 - $**	**27,775,000**
Total Voice and Data Radio Systems Cost				**$ 92,832,000 - $**	**141,043,000**
New Recurring Support Costs					
[25] New lease costs (all new and 25% of existing sites)	0	$ 2,000 - $ 2,500		$ - - $	-
[26] Added telco T-1 circuits (at 71% of new sites w/o mwave)	0	$ 500 - $ 700		$ - - $	-
Adjusted Voice and Data Radio System Cost				**$ 92,832,000 - $**	**141,043,000**

***** Industry average based on best available estimates; not based on any specific vendor product line. Ranges accommodate variances in competitive pricing features.

DEPARTMENT OF PARKS AND RECREATION

Continue migration to analog, 800 MHz, conventional technology with fill-in sites utilizing VHF high band frequencies. Replace analog equipment with digital equipment when existing equipment reaches the end of its useful life. The system configuration will reflect the required number of sites to support coverage in State Parks and along major transportation routes, and will consist of 410 sites (approximately 40% of the total anticipated number of VHF high band and 700/800 MHz sites required to meet amalgamated agency statewide coverage requirements). Implement dedicated mobile data network.

Configuration

Voice

1. One time replacement of existing fixed stations and addition of equipment at sites needed to provide improved coverage. Assumes three channels per site at 410 total sites. Also see note #'s 1, 2, & 3 on Alternative 2 Summary & Rationale (page D-24).

1(b). Calculates the number of in-building bi-directional amplifier/antenna systems required as being the number of console upgrades divided by two. Assumes one console upgrade per dispatch location, and that one out of two of these locations will require enhanced in-building coverage.

2. See Note #4 on Alternative 2 Summary & Rationale (page D-24).
3. See Note #5 on Alternative 2 Summary & Rationale (page D-24).
4. See Note #6 on Alternative 2 Summary & Rationale (page D-24).
5. See Note #7 on Alternative 2 Summary & Rationale page D-24).
6. Total number of voting systems reflects required interfaces with dispatching locations.
7. Interfaces with existing console positions.
8. See Note #10 on Alternative 2 Summary & Rationale (page D-24).
9. Assumes 80% of all required sites will undergo minor modifications.
10. Assumes 10% of all required sites will undergo major upgrades.
11. Assumes 10% of all required sites will be completely new sites.
12. One time replacement of existing mobile radio inventory. Assumes 3% factor for future growth. Assumes all hi-spec radios.
13. One time replacement of existing portable radio inventory. Assumes 3% factor for future growth. Assumes all hi-spec radios.
14. Replacement of existing fixed stations and receivers.
15. No addition or replacement of control stations and Remote Control Units.
16. No addition or replacement of mobile relays.
17. Upgrades to existing consoles (includes replacement of workstation electronics).

Data

18. Assumes average of 1 channel per site.
19. Three regional network controllers with redundancy.
20. Three regional message switches with backup.
21. Not included in cost model.
22. Each vehicle equipped with a mobile voice radio will also be equipped with mobile data (includes computer or terminal, radio, and RF modem).
23. Not included in cost model.
24. Not included in cost model.

New Recurring Costs

25. See Note #12 on Alternative 2 Summary & Rationale (page D-24).
26. Calculation assumes that ≈71% of the new sites without microwave will be serviced by leased T-1 or better circuits provided by the telephone company. See Note #'s 10 & 11 on Alternative 2 Summary & Rationale (page D-24) for details.

Required Infrastructure Cost Estimates
Department of Parks and Recreation

		**Per Unit Cost*		*Total Costs*	
	Quantity	*Low*	*High*	*Low*	*High*
Voice Radio System					
Backbone (based upon 410 total sites)					
[1a] Fixed Site Transceiver Equipment	1,230	$ 25,000	$ 35,000	$ 30,750,000	$ 43,050,000
[1b] In-Building Bi-Directional Amp/Antenna Systems	17	$ 40,000	$ 50,000	$ 680,000	$ 850,000
[2] Central System Controllers	18	$ 1,000,000	$ 1,400,000	$ 18,000,000	$ 25,200,000
[3] Simulcast Controllers	2	$ 250,000	$ 300,000	$ 500,000	$ 600,000
[4] System Controller	0	$ 150,000	$ 200,000	$ -	$ -
[5] Remote Site Controllers	401	$ 50,000	$ 65,000	$ 20,050,000	$ 26,065,000
[6] Voting System	34	$ 15,000	$ 20,000	$ 510,000	$ 680,000
[7] Console Interfaces	34	$ 8,000	$ 10,000	$ 272,000	$ 340,000
[8] Added Microwave Paths (to 29% of new sites w/o mwave)	47	$ 250,000	$ 350,000	$ 11,750,000	$ 16,450,000
[9] Minor Site Upgrades (to 80% of total sites)	328	$ 60,000	$ 90,000	$ 19,680,000	$ 29,520,000
[10] Major Site Upgrades (to 10% of total sites)	41	$ 500,000	$ 1,000,000	$ 20,500,000	$ 41,000,000
[11] New Site Acquisition (to 10% of total sites)	41	$ 500,000	$ 1,000,000	$ 20,500,000	$ 41,000,000
Design and Configuration (10% of equipment)				$ 8,251,200	$ 11,323,500
Installation/Integration/Training (25% of equipment)				$ 20,628,000	$ 28,308,750
Spare Equipment/Parts (3% of equipment)				$ 2,475,000	$ 3,397,050
Subtotal				**$ 174,546,000**	**$ 267,784,000**
User Equipment					
[12a] Mobile Radios (Hi Spec)	1,000	$ 3,100	$ 3,600	$ 3,100,000	$ 3,600,000
[13a] Portable Radios (Hi Spec)	840	$ 2,600	$ 3,400	$ 2,184,000	$ 2,856,000
[12b] Mobile Radios (Moderate Spec)	0	$ 2,400	$ 2,800	$ -	$ -
[13b] Portable Radios (Moderate Spec)	0	$ 2,000	$ 2,500	$ -	$ -
[14] Fixed Stations	270	$ 5,000	$ 7,500	$ 1,350,000	$ 2,025,000
[15] Control Stations/Remote Control Units	0	$ 5,000	$ 7,500	$ -	$ -
[16] Mobile Relays	0	$ 15,000	$ 17,000	$ -	$ -
[17] Console Upgrades	34	$ 50,000	$ 60,000	$ 1,700,000	$ 2,040,000
Installation/Integration/Training (10% of equipment)				$ 833,400	$ 1,052,000
Spare Equipment/Parts (3% of Eqpmt)				$ 250,000	$ 316,000
Subtotal				**$ 9,417,000**	**$ 11,889,000**
Implementation Support (2% of equipment)				$ 3,085,000	$ 4,780,000
Sales Tax (8% of equipment and services)				$ 12,587,000	$ 19,502,000
Contingency (15% of equipment and services)				$ 28,057,000	$ 42,668,000
Total Voice Radio System Cost				**$ 227,692,000**	**$ 346,623,000**
Data Radio System					
Backbone					
[18] Fixed Site Transceiver Equipment	410	$ 25,000	$ 40,000	$ 10,250,000	$ 16,400,000
[19] Network Controllers	6	$ 1,000,000	$ 1,250,000	$ 6,000,000	$ 7,500,000
[20] Message Switching	6	$ 2,000,000	$ 2,500,000	$ 12,000,000	$ 15,000,000
[21] Earth Station Links	0	$ 6,000	$ 8,000	$ -	$ -
Design and Configuration (10% of equipment)				$ 2,825,000	$ 3,890,000
Installation/Integration/Training (25% of equipment)				$ 7,062,500	$ 9,725,000
Spare Equipment (3% of equipment)				$ 847,500	$ 1,167,000
Subtotal				**$ 38,985,000**	**$ 53,682,000**
User Equipment					
[22] Mobile Data Devices	1,000	$ 5,000	$ 7,000	$ 5,000,000	$ 7,000,000
[23] Mobile Transceivers/Modems	0	$ 1,000	$ 3,500	$ -	$ -
[24] Transport Costs				$ -	$ -
Installation/Integration/Training (10% of equipment)				$ 500,000	$ 700,000
Spare Equipment (3% of equipment)				$ 150,000	$ 210,000
Subtotal				**$ 5,650,000**	**$ 7,910,000**
Implementation Support (2% of equipment)				$ 685,000	$ 946,000
Sales Tax (8% of equipment and services)				$ 2,795,000	$ 3,858,000
Contingency (15% of equipment and services)				$ 6,798,000	$ 9,381,000
Total Data Radio Cost				**$ 54,913,000**	**$ 75,777,000**
Total Voice and Data Radio Systems Cost				**$ 282,605,000**	**$ 422,400,000**
New Recurring Support Costs					
[25] New lease costs (all new and 25% of existing sites)	127	$ 2,000	$ 2,500	$ 45,810,000	$ 57,262,500
[26] Added telco T-1 circuits (at 71% of new sites w/o mwave)	113	$ 500	$ 700	$ 10,170,000	$ 14,238,000
Adjusted Voice and Data Radio System Cost				**$ 338,585,000**	**$ 493,901,000**

***** Industry average based on best available estimates; not based on any specific vendor product line. Ranges accommodate variances in competitive pricing features.

Continue migration to analog, 800 MHz, trunking technology. . Migrate to digital equipment as the existing analog equipment reaches the end of its useful life. The system configuration meeting Department unique coverage requirements will comprise 513 sites (approximately 50% of the total anticipated number of VHF high band and 700/800 MHz sites required to meet amalgamated agency statewide coverage requirements). Implement dedicated mobile data network.

Configuration

Voice

1. One time replacement of existing fixed stations and addition of equipment at sites needed to provide improved coverage. Assumes four channels per site at 513 total sites. Also see note #'s 1, 2, & 3 on Alternative 2 Summary & Rationale (page D-24).

1(b). Calculates the number of in-building bi-directional amplifier/antenna systems required as being the number of console upgrades divided by two. Assumes one console upgrade per dispatch location, and that one out of two of these locations will require enhanced in-building coverage.

2. See Note #4 on Alternative 2 Summary & Rationale (page D-24).
3. See Note #5 on Alternative 2 Summary & Rationale (page D-24).
4. See Note #6 on Alternative 2 Summary & Rationale (page D-24).
5. See Note #7 on Alternative 2 Summary & Rationale (page D-24).
6. Total number of voting systems reflects required interfaces with dispatching locations.
7. Interfaces with consoles at each of 13 dispatch centers (average of three per center).
8. See Note #10 on Alternative 2 Summary & Rationale (page D-24).
9. Assumes 80% of all required sites will undergo minor modifications.
10. Assumes 10% of all required sites will undergo major upgrades.
11. Assumes 10% of all required sites will be completely new sites.
12. One time replacement of existing radio inventory. Assumes 20% factor for future growth. Assumes all moderate-spec radios.
13. One time replacement of existing radio inventory. Assumes 20% factor for future growth. Assumes all moderate-spec radios.
14. No addition or replacement of fixed stations.
15. No addition or replacement of control stations or RCUs.
16. Included in replacement of fixed stations (see note #14).
17. Upgrades to three consoles at each of 13 dispatch centers (includes workstation electronics).

Data

18. Assumes average of 1 channel per site.
19. Two statewide network controllers with redundancy.
20. Two centralized message switches plus backup.
21. Not included in cost model.
22. Sixty-five percent of vehicles equipped with a mobile voice radio will also be equipped with mobile data (includes computer or terminal, radio, and RF modem).
23. Not included in cost model.
24. Not included in cost model.

New Recurring Costs

25. See Note #12 on Alternative 2 Summary & Rationale (page D-24).
26. Calculation assumes that ≈71% of the new sites without microwave will be serviced by leased T-1 or better circuits provided by the telephone company. See Note #'s 10 & 11 on Alternative 2 Summary & Rationale (page D-24) for details.

Required Infrastructure Cost Estimates
Department of Transportation

		**Per Unit Cost*		*Total Costs*	
	Quantity	***Low***	***High***	***Low***	***High***
Voice Radio System					
Backbone (based upon 513 total sites)					
[1a] Fixed Site Transceiver Equipment	2,050	$ 25,000	$ 35,000	$ 51,250,000	$ 71,750,000
[1b] In-Building Bi-Directional Amp/Antenna Systems	20	$ 40,000	$ 50,000	$ 780,000	$ 975,000
[2] Central System Controllers	18	$ 1,000,000	$ 1,400,000	$ 18,000,000	$ 25,200,000
[3] Simulcast Controllers	9	$ 250,000	$ 300,000	$ 2,250,000	$ 2,700,000
[4] System Controller	0	$ 150,000	$ 200,000	$ -	$ -
[5] Remote Site Controllers	504	$ 50,000	$ 65,000	$ 25,200,000	$ 32,760,000
[6] Voting System	39	$ 15,000	$ 20,000	$ 585,000	$ 780,000
[7] Console Interfaces	39	$ 8,000	$ 10,000	$ 312,000	$ 390,000
[8] Added Microwave Paths (to 29% of new sites w/o mwave)	77	$ 250,000	$ 350,000	$ 19,250,000	$ 26,950,000
[9] Minor Site Upgrades (to 80% of total sites)	410	$ 60,000	$ 90,000	$ 24,600,000	$ 36,900,000
[10] Major Site Upgrades (to 10% of total sites)	52	$ 500,000	$ 1,000,000	$ 26,000,000	$ 52,000,000
[11] New Site Acquisition (to 10% of total sites)	51	$ 500,000	$ 1,000,000	$ 25,250,000	$ 50,500,000
Design and Configuration (10% of equipment)				$ 11,762,700	$ 16,150,500
Installation/Integration/Training (25% of equipment)				$ 29,407,000	$ 40,376,250
Spare Equipment/Parts (3% of equipment)				$ 3,529,000	$ 4,845,150
Subtotal				**$ 238,176,000**	**$ 362,277,000**
User Equipment					
[12a] Mobile Radios (Hi Spec)	0	$ 3,100	$ 3,600	$ -	$ -
[13a] Portable Radios (Hi Spec)	0	$ 2,600	$ 3,400	$ -	$ -
[12b] Mobile Radios (Moderate Spec)	14,690	$ 2,400	$ 2,800	$ 35,256,000	$ 41,132,000
[13b] Portable Radios (Moderate Spec)	5,020	$ 2,000	$ 2,500	$ 10,040,000	$ 12,550,000
[14] Fixed Stations	0	$ 5,000	$ 7,500	$ -	$ -
[15] Control Stations/Remote Control Units	0	$ 5,000	$ 7,500	$ -	$ -
[16] Mobile Relays	0	$ 15,000	$ 17,000	$ -	$ -
[17] Console Upgrades	39	$ 50,000	$ 60,000	$ 1,950,000	$ 2,340,000
Installation/Integration/Training (10% of equipment)				$ 4,724,600	$ 5,602,000
Spare Equipment/Parts (3% of Eqpmt)				$ 1,417,000	$ 1,681,000
Subtotal				**$ 53,388,000**	**$ 63,305,000**
Implementation Support (2% of equipment)				$ 4,913,000	$ 7,269,000
Sales Tax (8% of equipment and services)				$ 20,047,000	$ 29,658,000
Contingency (15% of equipment and services)				$ 44,472,000	$ 64,928,000
Total Voice Radio System Cost				**$ 360,996,000**	**$ 527,437,000**
Data Radio System					
Backbone					
[18] Fixed Site Transceiver Equipment	513	$ 25,000	$ 40,000	$ 12,813,000	$ 20,500,000
[19] Network Controllers	4	$ 1,000,000	$ 1,250,000	$ 4,000,000	$ 5,000,000
[20] Message Switching	4	$ 2,000,000	$ 2,500,000	$ 8,000,000	$ 10,000,000
[21] Earth Station Links	0	$ 6,000	$ 8,000	$ -	$ -
Design and Configuration (10% of equipment)				$ 2,481,300	$ 3,550,000
Installation/Integration/Training (25% of equipment)				$ 6,203,250	$ 8,875,000
Spare Equipment (3% of equipment)				$ 744,390	$ 1,065,000
Subtotal				**$ 34,242,000**	**$ 48,990,000**
User Equipment					
[22] Mobile Data Devices	9,550	$ 5,000	$ 7,000	$ 47,750,000	$ 66,850,000
[23] Mobile Transceivers/Modems	0	$ 1,000	$ 3,500	$ -	$ -
[24] Transport Costs				$ -	$ -
Installation/Integration/Training (10% of equipment)				$ 4,775,000	$ 6,685,000
Spare Equipment (3% of equipment)				$ 1,432,500	$ 2,005,500
Subtotal				**$ 53,958,000**	**$ 75,541,000**
Implementation Support (2% of equipment)				$ 1,495,000	$ 2,108,000
Sales Tax (8% of equipment and services)				$ 6,099,000	$ 8,602,000
Contingency (15% of equipment and services)				$ 13,454,000	$ 18,996,000
Total Data Radio Cost				**$ 109,248,000**	**$ 154,237,000**
Total Voice and Data Radio Systems Cost				**$ 470,244,000**	**$ 681,674,000**
New Recurring Support Costs					
[25] New lease costs (all new and 25% of existing sites)	230	$ 2,000	$ 2,500	$ 82,710,000	$ 103,387,500
[26] Added telco T-1 circuits (at 71% of new sites w/o mwave)	186	$ 500	$ 700	$ 16,695,000	$ 23,373,000
Adjusted Voice and Data Radio System Cost				**$ 569,649,000**	**$ 808,435,000**

***** Industry average based on best available estimates; not based on any specific vendor product line. Ranges accommodate variances in competitive pricing features.

Upgrade VHF high band equipment with modern conventional technology in the same frequency band. The system configuration meeting Department unique coverage requirements will comprise 107 sites (approximately 25% of the total anticipated number of VHF high band sites required to meet amalgamated agency statewide coverage requirements).

Configuration

Voice

1. One time replacement of existing fixed stations and addition of equipment at sites needed to provide improved coverage. Assumes three channels per site at 107 total sites. Also see note #'s 1, 2, & 3 on Alternative 2 Summary & Rationale (page D-24).

1(b). Calculates the number of in-building bi-directional amplifier/antenna systems required as being the number of console upgrades divided by two. Assumes one console upgrade per dispatch location, and that one out of two of these locations will require enhanced in-building coverage.

2. See Note #4 on Alternative 2 Summary & Rationale (page D-24).
3. See Note #5 on Alternative 2 Summary & Rationale (page D-24).
4. See Note #6 on Alternative 2 Summary & Rationale (page D-24).
5. See Note #7 on Alternative 2 Summary & Rationale (page D-24).
6. Total number of voting systems reflects required interfaces with dispatching locations.
7. Interfaces to one console position at each of two operational centers.
8. See Note #10 on Alternative 2 Summary & Rationale (page D-24).
9. Assumes 80% of all required sites will undergo minor modifications.
10. Assumes 10% of all required sites will undergo major upgrades.
11. Assumes 10% of all required sites will be completely new sites.
12. Replacement of existing radio inventory. Assumes all moderate-spec radios.
13. Replacement of existing radio inventory. Assumes all moderate-spec radios.
14. No addition or replacement of existing fixed stations.
15. Replacement of existing RCUs.
16. Replacement of fixed stations (see note #14).
17. Automatic Vehicle Location upgrade (geographic displays) to existing consoles.

Data

18. Not included in cost model.
19. Not included in cost model.
20. Not included in cost model.
21. Not included in cost model.
22. Not included in cost model.
23. Not included in cost model.
24. Not included in cost model.

New Recurring Costs

25. See Note #12 on Alternative 2 Summary & Rationale (page D-24).
26. Calculation assumes that ≈71% of the new sites without microwave will be serviced by leased T-1 or better circuits provided by the telephone company. See Note #'s 10 & 11 on Alternative 2 Summary & Rationale (page D-24) for details.

Required Infrastructure Cost Estimates
Department of Water Resources

		**Per Unit Cost*		*Total Costs*	
	Quantity	***Low***	***High***	***Low***	***High***
Voice Radio System					
Backbone (based upon 107 total sites)					
[1a] Fixed Site Transceiver Equipment	320	$ 25,000	$ 35,000	$ 8,006,000	$ 11,208,750
[1b] In-Building Bi-Directional Amp/Antenna Systems	1	$ 40,000	$ 50,000	$ 40,000	$ 50,000
[2] Central System Controllers	0	$ 1,000,000	$ 1,400,000	$ -	$ -
[3] Simulcast Controllers	0	$ 250,000	$ 300,000	$ -	$ -
[4] System Controller	0	$ 150,000	$ 200,000	$ -	$ -
[5] Remote Site Controllers	0	$ 50,000	$ 65,000	$ -	$ -
[6] Voting System	2	$ 15,000	$ 20,000	$ 30,000	$ 40,000
[7] Console Interfaces	2	$ 8,000	$ 10,000	$ 16,000	$ 20,000
[8] Added Microwave Paths (to 29% of new sites w/o mwave)	0	$ 250,000	$ 350,000	$ -	$ -
[9] Minor Site Upgrades (to 80% of total sites)	86	$ 60,000	$ 90,000	$ 5,160,000	$ 7,740,000
[10] Major Site Upgrades (to 10% of total sites)	11	$ 500,000	$ 1,000,000	$ 5,500,000	$ 11,000,000
[11] New Site Acquisition (to 10% of total sites)	10	$ 500,000	$ 1,000,000	$ 4,875,000	$ 9,750,000
Design and Configuration (10% of equipment)				$ 809,200	$ 1,131,875
Installation/Integration/Training (25% of equipment)				$ 2,023,000	$ 2,829,688
Spare Equipment/Parts (3% of equipment)				$ 243,000	$ 339,563
Subtotal				**$ 26,702,000**	**$ 44,110,000**
User Equipment					
[12a] Mobile Radios (Hi Spec)	0	$ 3,100	$ 3,600	$ -	$ -
[13a] Portable Radios (Hi Spec)	0	$ 2,600	$ 3,400	$ -	$ -
[12b] Mobile Radios (Moderate Spec)	791	$ 2,400	$ 2,800	$ 1,898,000	$ 2,215,000
[13b] Portable Radios (Moderate Spec)	239	$ 2,000	$ 2,500	$ 478,000	$ 598,000
[14] Fixed Stations	0	$ 5,000	$ 7,500	$ -	$ -
[15] Control Stations/Remote Control Units	53	$ 5,000	$ 7,500	$ 265,000	$ 398,000
[16] Mobile Relays	0	$ 15,000	$ 17,000	$ -	$ -
[17] Console Upgrades	2	$ 50,000	$ 60,000	$ 100,000	$ 120,000
Installation/Integration/Training (10% of equipment)				$ 274,100	$ 333,000
Spare Equipment/Parts (3% of Eqpmt)				$ 82,000	$ 100,000
Subtotal				**$ 3,097,000**	**$ 3,764,000**
Implementation Support (2% of equipment)				$ 534,000	$ 872,000
Sales Tax (8% of equipment and services)				$ 2,178,000	$ 3,556,000
Contingency (15% of equipment and services)				$ 4,550,000	$ 7,312,000
Total Voice Radio System Cost				**$ 37,061,000**	**$ 59,614,000**
Data Radio System					
Backbone					
[18] Fixed Site Transceiver Equipment	0	$ 25,000	$ 40,000	$ -	$ -
[19] Network Controllers	0	$ 1,000,000	$ 1,250,000	$ -	$ -
[20] Message Switching	0	$ 2,000,000	$ 2,500,000	$ -	$ -
[21] Earth Station Links	0	$ 6,000	$ 8,000	$ -	$ -
Design and Configuration (10% of equipment)				$ -	$ -
Installation/Integration/Training (25% of equipment)				$ -	$ -
Spare Equipment (3% of equipment)				$ -	$ -
Subtotal				**$ -**	**$ -**
User Equipment					
[22] Mobile Data Devices	0	$ 5,000	$ 7,000	$ -	$ -
[23] Mobile Transceivers/Modems	0	$ 1,000	$ 3,500	$ -	$ -
[24] Transport Costs				$ -	$ -
Installation/Integration/Training (10% of equipment)				$ -	$ -
Spare Equipment (3% of equipment)				$ -	$ -
Subtotal				**$ -**	**$ -**
Implementation Support (2% of equipment)				$ -	$ -
Sales Tax (8% of equipment and services)				$ -	$ -
Contingency (15% of equipment and services)				$ -	$ -
Total Data Radio Cost				**$ -**	**$ -**
Total Voice and Data Radio Systems Cost				**$ 37,061,000**	**$ 59,614,000**
New Recurring Support Costs					
[25] New lease costs (all new and 25% of existing sites)	0	$ 2,000	$ 2,500	$ -	$ -
[26] Added telco T-1 circuits (at 71% of new sites w/o mwave)	0	$ 500	$ 700	$ -	$ -
Adjusted Voice and Data Radio System Cost				**$ 37,061,000**	**$ 59,614,000**

***** Industry average based on best available estimates; not based on any specific vendor product line. Ranges accommodate variances in competitive pricing features.

DEPARTMENT OF THE YOUTH AUTHORITY

Continue implementation of 800 MHz, trunked and conventional radio systems for Transportation and Institutions and maintain VHF high band capability for Paroles based on regional system infrastructures. System configuration is to provide radio coverage to major transportation routes and in the immediate areas surrounding Youth Authority correctional facilities. The projected number of sites required to provide this coverage is 338 sites (approximately 33% of the total anticipated number of VHF high band and 700/800 MHz sites required to meet amalgamated agency statewide coverage requirements). Migrate to digital equipment as the existing analog equipment reaches the end of its useful life. Implement a dedicated mobile data network.

Configuration

Voice

1. One time replacement of existing fixed stations and addition of equipment at sites needed to provide improved coverage. Assumes three channels per site at 338 total sites. Also see note #'s 1, 2, & 3 on Alternative 2 Summary & Rationale (page D-24).

1(b). Calculates the number of in-building bi-directional amplifier/antenna systems required as being the number of console upgrades divided by two. Assumes one console upgrade per dispatch location, and that one out of two of these locations will require enhanced in-building coverage.

2. See Note #4 on Alternative 2 Summary & Rationale (page D-24).
3. See Note #5 on Alternative 2 Summary & Rationale (page D-24).
4. See Note #6 on Alternative 2 Summary & Rationale (page D-24).
5. See Note #7 on Alternative 2 Summary & Rationale (page D-24).
6. Total number of voting systems reflects required interfaces with institution control stations.
7. Interfaces for one console at each of 13 institutions.
8. See Note #10 on Alternative 2 Summary & Rationale (page D-24).
9. Assumes 80% of all required sites will undergo minor modifications.
10. Assumes 10% of all required sites will undergo major upgrades.
11. Assumes 10% of all required sites will be completely new sites.
12. Replacement of existing radio inventory. Assumes 25% factor for future growth. Assumes all hi-spec radios.
13. Replacement of existing radio inventory. Assumes 25% factor for future growth. Assumes all hi-spec radios.
14. No addition or replacement of existing fixed stations.
15. No addition or replacement of existing control stations or RCUs.
16. No replacement of fixed stations (see note #14).
17. Upgrades to consoles identified in note #7 (includes workstation electronics).

Data

18. Assumes average of 1 channel per site.
19. Single network controller with redundancy.
20. One centralized message switch plus backup.
21. Not included in cost model.
22. Each vehicle equipped with a mobile voice radio will also be equipped with mobile data (includes computer or terminal, radio, and RF modem).
23. Not included in cost model.
24. Not included in cost model.

New Recurring Costs

25. See Note #12 on Alternative 2 Summary & Rationale (page D-24).
26. Calculation assumes that ≈71% of the new sites without microwave will be serviced by leased T-1 or better circuits provided by the telephone company. See Note #'s 10 & 11 on Alternative 2 Summary & Rationale (page D-24) for details.

Required Infrastructure Cost Estimates
Department of the Youth Authority

		**Per Unit Cost*		*Total Costs*	
	Quantity	*Low*	*High*	*Low*	*High*
Voice Radio System					
Backbone (based upon 338 total sites)					
[1a] Fixed Site Transceiver Equipment	1,015	$ 25,000	$ 35,000	$ 25,369,000	$ 35,516,250
[1b] In-Building Bi-Directional Amp/Antenna Systems	7	$ 40,000	$ 50,000	$ 260,000	$ 325,000
[2] Central System Controllers	16	$ 1,000,000	$ 1,400,000	$ 16,000,000	$ 22,400,000
[3] Simulcast Controllers	0	$ 250,000	$ 300,000	$ -	$ -
[4] System Controller	17	$ 150,000	$ 200,000	$ 2,550,000	$ 3,400,000
[5] Remote Site Controllers	331	$ 50,000	$ 65,000	$ 16,550,000	$ 21,515,000
[6] Voting System	13	$ 15,000	$ 20,000	$ 195,000	$ 260,000
[7] Console Interfaces	13	$ 8,000	$ 10,000	$ 104,000	$ 130,000
[8] Added Microwave Paths (to 29% of new sites w/o mwave)	26	$ 250,000	$ 350,000	$ 6,500,000	$ 9,100,000
[9] Minor Site Upgrades (to 80% of total sites)	271	$ 60,000	$ 90,000	$ 16,260,000	$ 24,390,000
[10] Major Site Upgrades (to 10% of total sites)	34	$ 500,000	$ 1,000,000	$ 17,000,000	$ 34,000,000
[11] New Site Acquisition (to 10% of total sites)	33	$ 500,000	$ 1,000,000	$ 16,625,000	$ 33,250,000
Design and Configuration (10% of equipment)				$ 6,752,800	$ 9,264,625
Installation/Integration/Training (25% of equipment)				$ 16,882,000	$ 23,161,563
Spare Equipment/Parts (3% of equipment)				$ 2,026,000	$ 2,779,388
Subtotal				**$ 143,074,000**	**$ 219,492,000**
User Equipment					
[12a] Mobile Radios (Hi Spec)	240	$ 3,100	$ 3,600	$ 744,000	$ 864,000
[13a] Portable Radios (Hi Spec)	1,380	$ 2,600	$ 3,400	$ 3,588,000	$ 4,692,000
[12b] Mobile Radios (Moderate Spec)		$ 2,400	$ 2,800	$ -	$ -
[13b] Portable Radios (Moderate Spec)		$ 2,000	$ 2,500	$ -	$ -
[14] Fixed Stations	0	$ 5,000	$ 7,500	$ -	$ -
[15] Control Stations/Remote Control Units	0	$ 5,000	$ 7,500	$ -	$ -
[16] Mobile Relays	0	$ 15,000	$ 17,000	$ -	$ -
[17] Console Upgrades	13	$ 50,000	$ 60,000	$ 650,000	$ 780,000
Installation/Integration/Training (10% of equipment)				$ 498,200	$ 634,000
Spare Equipment/Parts (3% of Eqpmt)				$ 149,000	$ 190,000
Subtotal				**$ 5,629,000**	**$ 7,160,000**
Implementation Support (2% of equipment)				$ 2,491,000	$ 3,872,000
Sales Tax (8% of equipment and services)				$ 10,165,000	$ 15,797,000
Contingency (15% of equipment and services)				$ 22,679,000	$ 34,579,000
Total Voice Radio System Cost				**$ 184,038,000**	**$ 280,900,000**
Data Radio System					
Backbone					
[18] Fixed Site Transceiver Equipment	338	$ 25,000	$ 40,000	$ 8,456,000	$ 13,530,000
[19] Network Controllers	2	$ 1,000,000	$ 1,250,000	$ 2,000,000	$ 2,500,000
[20] Message Switching	2	$ 2,000,000	$ 2,500,000	$ 4,000,000	$ 5,000,000
[21] Earth Station Links	0	$ 6,000	$ 8,000	$ -	$ -
Design and Configuration (10% of equipment)				$ 1,445,600	$ 2,103,000
Installation/Integration/Training (25% of equipment)				$ 3,614,000	$ 5,257,500
Spare Equipment (3% of equipment)				$ 433,680	$ 630,900
Subtotal				**$ 19,949,000**	**$ 29,021,000**
User Equipment					
[22] Mobile Data Devices	240	$ 5,000	$ 7,000	$ 1,200,000	$ 1,680,000
[23] Mobile Transceivers/Modems	0	$ 1,000	$ 3,500	$ -	$ -
[24] Transport Costs				$ -	$ -
Installation/Integration/Training (10% of equipment)				$ 120,000	$ 168,000
Spare Equipment (3% of equipment)				$ 36,000	$ 50,400
Subtotal				**$ 1,356,000**	**$ 1,898,000**
Implementation Support (2% of equipment)				$ 323,000	$ 468,000
Sales Tax (8% of equipment and services)				$ 1,316,000	$ 1,909,000
Contingency (15% of equipment and services)				$ 3,244,000	$ 4,708,000
Total Data Radio Cost				**$ 26,188,000**	**$ 38,004,000**
Total Voice and Data Radio Systems Cost				**$ 210,226,000**	**$ 318,904,000**
New Recurring Support Costs					
[25] New lease costs (all new and 25% of existing sites)	56	$ 2,000	$ 2,500	$ 19,980,000	$ 24,975,000
[26] Added telco T-1 circuits (at 71% of new sites w/o mwave)	62	$ 500	$ 700	$ 5,602,500	$ 7,843,500
Adjusted Voice and Data Radio System Cost				**$ 235,809,000**	**$ 351,723,000**

***** Industry average based on best available estimates; not based on any specific vendor product line. Ranges accommodate variances in competitive pricing features.

GOVERNOR'S OFFICE OF EMERGENCY SERVICES

Upgrade VHF high band technology with modern conventional equipment. The system configuration meeting Department unique coverage requirements will comprise 235 sites (approximately 85% of the total anticipated number of VHF high band sites required to meet amalgamated agency statewide coverage requirements). Maintain mutual aid networks in 800 MHz and UHF Bands. Implement satellite mobile data.

Configuration

Voice

1. One time replacement of existing fixed stations and addition of equipment at sites needed to provide improved coverage. Assumes three channels per site at 235 total sites. Also see note #'s 1, 2, & 3 on Alternative 2 Summary & Rationale (page D-24).

1(b). Calculates the number of in-building bi-directional amplifier/antenna systems required as being the number of console upgrades divided by two. Assumes one console upgrade per dispatch location, and that one out of two of these locations will require enhanced in-building coverage.

2. See Note #4 on Alternative 2 Summary & Rationale (page D-24).
3. See Note #5 on Alternative 2 Summary & Rationale (page D-24).
4. See Note #6 on Alternative 2 Summary & Rationale (page D-24).
5. See Note #7 on Alternative 2 Summary & Rationale (page D-24).
6. Total number of voting systems reflects required interfaces with dispatching locations.
7. Interfaces for two consoles at each of three administrative regions and two each at fire centers in Riverside and Redding.
8. See Note #10 on Alternative 2 Summary & Rationale (page D-24).
9. Assumes 90% of all required sites will undergo minor modifications.
10. Assumes 10% of all required sites will undergo major upgrades.
11. Not included in cost model.
12. One time replacement of existing radio inventory. Assumes 10% factor for future growth. Assumes all hi-spec radios.
13. One time replacement of existing radio inventory. Assumes 10% factor for future growth. Assumes all hi-spec radios.
14. No addition or replacement of fixed stations.
15. No addition or replacement of control stations or RCUs.
16. Not addition or replacement of mobile relays (see Note #14).
17. Upgrades to consoles identified above (includes workstation electronics).

Data

18. Assumes use of satellite platform for mobile data..
19. Not included in cost model.
20. Not included in cost model.
21. Leased satellite services.
22. Equips 30 OES vehicles, 109 OES owned fire trucks and three communications vans with mobile data (includes computer or terminal, radio, and RF modem).
23. Not included in cost model.
24. Not included in cost model.

New Recurring Costs

25. See Note #12 on Alternative 2 Summary & Rationale (page D-24).
26. Calculation assumes that ≈71% of the new sites without microwave will be serviced by leased T-1 or better circuits provided by the telephone company. See Note #'s 10 & 11 on Alternative 2 Summary & Rationale (page D-24) for details.

Required Infrastructure Cost Estimates
Governor's Office of Emergency Services

		**Per Unit Cost*		*Total Costs*	
	Quantity	*Low*	*High*	*Low*	*High*
Voice Radio System					
Backbone (based upon 235 total sites)					
[1a] Fixed Site Transceiver Equipment	705	$ 25,000 - $ 35,000		$ 17,614,000 - $	24,659,250
[1b] In-Building Bi-Directional Amp/Antenna Systems	5	$ 40,000 - $ 50,000		$ 200,000 - $	250,000
[2] Central System Controllers	0	$ 1,000,000 - $ 1,400,000		$ - - $	-
[3] Simulcast Controllers	2	$ 250,000 - $ 300,000		$ 500,000 - $	600,000
[4] System Controller	0	$ 150,000 - $ 200,000		$ - - $	-
[5] Remote Site Controllers	0	$ 50,000 - $ 65,000		$ - - $	-
[6] Voting System	10	$ 15,000 - $ 20,000		$ 150,000 - $	200,000
[7] Console Interfaces	10	$ 8,000 - $ 10,000		$ 80,000 - $	100,000
[8] Added Microwave Paths (to 29% of new sites w/o mwave)	0	$ 250,000 - $ 350,000		$ - - $	-
[9] Minor Site Upgrades (to 90% of total sites)	211	$ 60,000 - $ 90,000		$ 12,651,000 - $	18,976,500
[10] Major Site Upgrades (to 10% of total sites)	24	$ 500,000 - $ 1,000,000		$ 12,000,000 - $	24,000,000
[11] New Site Acquisition (to 0% of total sites)	0	$ 500,000 - $ 1,000,000		$ - - $	-
Design and Configuration (10% of equipment)				$ 1,854,400 - $	2,580,925
Installation/Integration/Training (25% of equipment)				$ 4,636,000 - $	6,452,313
Spare Equipment/Parts (3% of equipment)				$ 556,000 - $	774,278
Subtotal				**$ 50,241,000 - $**	**78,593,000**
User Equipment					
[12a] Mobile Radios (Hi Spec)	0	$ 3,100 - $ 3,600		$ - - $	-
[13a] Portable Radios (Hi Spec)	0	$ 2,600 - $ 3,400		$ - - $	-
[12b] Mobile Radios (Moderate Spec)	561	$ 2,400 - $ 2,800		$ 1,346,000 - $	1,571,000
[13b] Portable Radios (Moderate Spec)	583	$ 2,000 - $ 2,500		$ 1,166,000 - $	1,458,000
[14] Fixed Stations	0	$ 5,000 - $ 7,500		$ - - $	-
[15] Control Stations/Remote Control Units	0	$ 5,000 - $ 7,500		$ - - $	-
[16] Mobile Relays	0	$ 15,000 - $ 17,000		$ - - $	-
[17] Console Upgrades	10	$ 50,000 - $ 60,000		$ 500,000 - $	600,000
Installation/Integration/Training (10% of equipment)				$ 301,200 - $	363,000
Spare Equipment/Parts (3% of Eqpmt)				$ 90,000 - $	109,000
Subtotal				**$ 3,403,000 - $**	**4,101,000**
Implementation Support (2% of equipment)				$ 937,000 - $	1,466,000
Sales Tax (8% of equipment and services)				$ 3,823,000 - $	5,981,000
Contingency (15% of equipment and services)				$ 8,187,000 - $	12,624,000
Total Voice Radio System Cost				**$ 66,591,000 - $**	**102,765,000**
Data Radio System					
Backbone					
[18] Fixed Site Transceiver Equipment	0	$ 25,000 - $ 40,000		$ - - $	-
[19] Network Controllers	0	$ 1,000,000 - $ 1,250,000		$ - - $	-
[20] Message Switching	0	$ 2,000,000 - $ 2,500,000		$ - - $	-
[21] Earth Station Links	3	$ 6,000 - $ 8,000		$ 18,000 - $	24,000
Design and Configuration (10% of equipment)				$ 1,800 - $	2,400
Installation/Integration/Training (25% of equipment)				$ 4,500 - $	6,000
Spare Equipment (3% of equipment)				$ 540 - $	720
Subtotal				**$ 25,000 - $**	**33,000**
User Equipment					
[22] Mobile Data Devices	142	$ 5,000 - $ 7,000		$ 710,000 - $	994,000
[23] Mobile Transceivers/Modems	0	$ 1,000 - $ 3,500		$ - - $	-
[24] Transport Costs				$ 3,960,000 - $	5,544,000
Installation/Integration/Training (10% of equipment)				$ 467,000 - $	654,000
Spare Equipment (3% of equipment)				$ 21,300 - $	29,820
Subtotal				**$ 5,158,000 - $**	**7,222,000**
Implementation Support (2% of equipment)				$ 94,000 - $	132,000
Sales Tax (8% of equipment and services)				$ 384,000 - $	538,000
Contingency (15% of equipment and services)				$ 792,000 - $	1,108,000
Total Data Radio Cost				**$ 6,453,000 - $**	**9,033,000**
Total Voice and Data Radio Systems Cost				**$ 73,044,000 - $**	**111,798,000**
New Recurring Support Costs					
[25] New lease costs (all new and 25% of existing sites)	0	$ 2,000 - $ 2,500		$ - - $	-
[26] Added telco T-1 circuits (at 71% of new sites w/o mwave)	0	$ 500 - $ 700		$ - - $	-
Adjusted Voice and Data Radio System Cost				**$ 73,044,000 - $**	**111,798,000**

***** Industry average based on best available estimates; not based on any specific vendor product line. Ranges accommodate variances in competitive pricing features.

SUMMARY COST MODEL
Alternative 2 – Agency Independent Initiatives (Aggregate Total)

ONE-TIME

Voice

1. Represents aggregate total of all Departments. Equipment costs include antennas, feed lines, mounting hardware, brackets, programming, etc.

1(b). Calculates the number of in-building bi-directional amplifier/antenna systems required as being the number of console upgrades divided by two. Assumes one console upgrade per dispatch location, and that one out of two of these locations will require enhanced in-building coverage.

2. See Note #4 on Alternative 2 Summary & Rationale (page D-24). Assumes 25% inefficiency factor.

3. See Note #5 on Alternative 2 Summary & Rationale (page D-24).

4. See Note #6 on Alternative 2 Summary & Rationale (page D-24).

5. See Note #7 on Alternative 2 Summary & Rationale (page D-24). Assumes 25% inefficiency factor.

6. Total number of voting systems reflects required interfaces with dispatching locations.

7. Provides upgraded interface to existing console positions (e.g. trunking or digital modes).

8. See Note #10 on Alternative 2 Summary & Rationale (page D-24).

9. Assumes that individual systems implementations by Departments would result in some site development redundancies, but not total redundancy. Calculation assumes 35% inefficiency factor; i.e., the total number of sites incorporated in individual designs is approximately 35% of the sum of the sites required by each agency acting independently. Eighty percent of required sites will undergo minor modifications.

10. See Note 9. Ten percent of required sites will undergo major upgrades.

11. See Note 9. Ten percent of required sites will be completely new sites.

12. Costs include one-time replacement of mobile radio inventories, plus new equipment to accommodate projected growth over 15 years. Assumes hi-spec radios.

12(b). See Note #12.a. Assumes moderate-spec radios.

13. Costs include one-time replacement of portable radio inventories, plus new equipment to accommodate projected growth over 15 years. Assumes hi-spec radios.

13(b). See Note #13.a. Assumes moderate-spec radios.

14. Costs include 450 fixed stations at $10,000 to $15,000 each for CDF, and 485 fixed stations at $5,000 to $7,500 for all other participating agencies.

15. Costs include 400 control stations and RCUs at $6,000 to $7,500 each for CDF, and 375 control stations and RCUs at $5,000 to $7,500 for all other participating agencies.

16. Costs include one-time replacement of existing CDF mobile relays (200). Required replacement costs for all other existing mobile relays included in Fixed Stations.

17. Costs consider replacement of workstation electronics.

Data

18. Costs include aggregate of fixed site transceiver equipment for user-owned mobile data networks.

19. Costs include aggregate of network controllers for user-owned mobile data network with redundancy.

20. Provides aggregate of points of interface and routing for host computer system with backup.

21. Costs include Earth station links for leased satellite services. Assumes both CDF and OES will lease mobile data services.

22. Costs include computer or terminal, radio, and RF modem.

23. Costs include mobile transceivers and modems for data devices operating on leased satellite services. Costs associated with CDF only.

24. Transport costs are for commercially provided mobile data infrastructure. Assumes $25 to $35 per unit per month for 12 years. Cost range includes miscellaneous taxes. Costs associated with CDF only.

Recurring

25. See Note #12 on Alternative 2 Summary & Rationale (page D-24).

26. Calculation assumes that ≈71% of the new sites without microwave will be serviced by leased T-1 or better circuits provided by the telephone company. See Note #'s 10 & 11 on Alternative 2 Summary & Rationale (page D-24) for details.

27. Costs include preventative equipment maintenance, repair, parts, and service. Estimate based on current Baseline expenditures as a factor of total fixed, mobile, and portable unit inventories. High costs include 15% contingency over 15 years to accommodate unanticipated expenditures.

28. Costs include engineering, maintenance, installation, test, and replacement equipment, vault rental and depreciation. Estimates based on current Baseline expenditures. High costs include 15% contingency over 15 years to accommodate unanticipated expenditures.

29. Costs include technical design and engineering support for new, replacement, and modification of existing systems. Estimates based on current Baseline expenditures. High costs include 15% contingency over 15 years to accommodate unanticipated expenditures. Engineering costs associated with implementation of new voice and data systems included in one-time costs.

30. Costs include VHF installation and maintenance. Estimates based on current Baseline expenditures. High costs include 15% contingency over 15 years to accommodate unanticipated expenditures.

31. Costs include parts, materials, and private sector contracts. Estimates based on current Baseline expenditures. High costs include 15% contingency over 15 years to accommodate unanticipated expenditures.

Required Infrastructure Cost Estimates
10 Independent Agency Initiatives -- Aggregate Cost Summary

ONE TIME COSTS	*Quantity*	**Per Unit Cost Low*	**Per Unit Cost High*	*Total Costs Low*	*Total Costs High*
Voice Radio System					
Multiple Backbones (resulting in 1,364 total sites)					
[1a] Fixed Site Transceiver Equipment	13,132	$ 25,000	$ 35,000	$ 328,311,000	$ 459,634,700
[1b] In-Building Bi-Directional Amp/Antenna System	159	$ 40,000	$ 50,000	$ 6,340,000	$ 7,925,000
[2] Central System Controllers	78	$ 1,000,000	$ 1,400,000	$ 78,000,000	$ 109,200,000
[3] Simulcast Controllers	30	$ 250,000	$ 300,000	$ 7,500,000	$ 9,000,000
[4] System Controller	49	$ 150,000	$ 200,000	$ 7,350,000	$ 9,800,000
[5] Remote Site Controllers	1667	$ 50,000	$ 65,000	$ 83,350,000	$ 108,355,000
[6] Voting System	203	$ 15,000	$ 20,000	$ 3,045,000	$ 4,060,000
[7] Console Interfaces	317	$ 8,000	$ 10,000	$ 2,536,000	$ 3,170,000
[8] Added Microwave Paths (to 29% of new sites w/o µwave)	323	$ 250,000	$ 350,000	$ 80,777,615	$ 113,088,661
[9] Minor Site Upgrades	1,111	$ 60,000	$ 90,000	$ 66,650,850	$ 99,976,275
[10] Major Site Upgrades	127	$ 500,000	$ 1,500,000	$ 63,525,000	$ 190,575,000
[11] New Site Acquisition	126	$ 500,000	$ 1,000,000	$ 63,138,250	$ 126,276,500
Design and Configuration (10% of equipment)				$ 59,720,962	$ 82,423,336
Installation/Integration/Training (25% of equipment)				$ 149,302,000	$ 206,058,340
Spare Equipment/parts (3% of equipment)				$ 17,916,000	$ 24,727,001
Subtotal				**$ 1,017,462,677**	**$ 1,554,269,813**
User Equipment					
[12a] Mobile Radios (Hi Spec)	15,757	$ 3,100	$ 3,600	$ 48,847,000	$ 56,725,000
[13a] Portable Radios (Hi Spec)	21,980	$ 2,600	$ 3,400	$ 57,148,000	$ 74,732,000
[12b] Mobile Radios (Moderate Spec)	16,624	$ 2,400	$ 2,800	$ 39,898,000	$ 46,547,000
[13b] Portable Radios (Moderate Spec)	8,467	$ 2,000	$ 2,500	$ 16,934,000	$ 21,168,000
[14] Fixed Stations	932	$ 5,000	$ 7,500	$ 4,660,000	$ 6,990,000
[15] Control Stations/Remote Control Units	1,023	$ 5,000	$ 7,500	$ 5,115,000	$ 7,673,000
[16] Mobile Relays	200	$ 15,000	$ 17,000	$ 3,000,000	$ 3,400,000
[17] Console Upgrades	317	$ 50,000	$ 60,000	$ 15,850,000	$ 19,020,000
Installation/Integration/Training (10% of equipment)				$ 19,145,200	$ 23,626,000
Spare Equipment/Parts (3% of Eqpmt)				$ 5,744,000	$ 7,088,000
Subtotal				**$ 216,341,200**	**$ 266,969,000**
Implementation Support (2% of equipment)				$ 20,113,000	$ 30,183,000
Sales Tax (8% of equipment)				$ 82,060,000	$ 123,145,000
Contingency (15% of equipment and services)				$ 188,088,000	$ 277,713,000
Total Voice Radio System Cost				**$ 1,524,064,877**	**$ 2,252,279,813**
Data Radio System					
Backbone					
[18] Fixed Site Transceiver Equipment	2,046	$ 25,000	$ 40,000	$ 51,157,000	$ 81,850,000
[19] Network Controllers	30	$ 1,000,000	$ 1,250,000	$ 30,000,000	$ 37,500,000
[20] Message Switching	30	$ 2,000,000	$ 2,500,000	$ 60,000,000	$ 75,000,000
[21] Earth Station Links	32	$ 6,000	$ 8,000	$ 192,000	$ 256,000
Design and Configuration (10% of equipment)				$ 14,134,900	$ 19,460,600
Installation/Integration/Training (25% of equipment)				$ 35,337,250	$ 48,651,500
Spare Equipment (3% of equipment)				$ 4,240,470	$ 5,838,180
Subtotal				**$ 195,061,620**	**$ 268,556,280**
User Equipment				$ -	$ -
[22] Mobile Data Devices	19,126	$ 5,000	$ 7,000	$ 95,630,000	$ 133,882,000
[23] Mobile Transceivers/Modems	1,100	$ 1,000	$ 3,500	$ 1,100,000	$ 3,850,000
[24] Transport Costs	0			$ 7,920,000	$ 11,088,000
Installation/Integration/Training (10% of equipment)				$ 10,465,000	$ 14,882,000
Spare Equipment (3% of equipment)				$ 2,901,900	$ 4,131,960
Subtotal				**$ 118,017,000**	**$ 167,834,000**
Implementation Support (2% of equipment)				$ 5,063,000	$ 7,068,000
Sales Tax (8% of equipment)				$ 20,656,000	$ 28,837,000
Contingency (15% of equipment and services)				$ 47,721,000	$ 66,519,000
Total Data Radio Cost				**$ 386,519,000**	**$ 538,814,000**
Total Voice and Data Radio Systems Cost				**$ 1,910,583,877**	**$ 2,791,093,813**
RECURRING SUPPORT COSTS					
[25] New lease costs (all new and 25% of existing sites)	931	$ 2,000	$ 2,500	$ 335,222,640	$ 419,028,300
[26] Added telco T-1 circuits (at 71% of new sites w/o µwave)	791	$ 500	$ 700	$ 71,195,719	$ 99,674,006
[27] Unit Costs				$ 285,645,000	$ 328,500,000
[28] Microwave Services				$ 96,000,000	$ 104,000,000
[29] Engineering				$ 205,000,000	$ 222,000,000
[30] Technician Services				$ 192,000,000	$ 206,000,000
[31] Miscellaneous Flow Through				$ 120,000,000	$ 129,000,000
Total Recurring Support Costs				**$1,305,063,359**	**$1,508,202,306**
TOTAL 15 YEAR COSTS				***$3,215,647,235***	***$4,299,296,119***

* Industry average based on best available estimates; not based on any specific vendor product line. Ranges accommodate variances in competitive pricing features.

Alternative 2
Agency Independent Initiatives
Systems Configuration Assumptions

1. Number of sites required for statewide radio coverage per coverage predictions. Includes the following reserves: 50 - VHF HB sites and 123 - 700/800 MHz sites for unique agency service area requirements.
2. Number of sites needed for radio coverage required to support Department mission ("Note 1" times "Note 3")
3. Percent of statewide coverage needed to support Department mission.
4. Value is "0" if system is conventional. If trunked, then a maximum of 48 cells can be controlled by each system controller, and each simulcast cell can handle 11 sites; i.e., for a system with 1,025 sites and 9 simulcast controllers, the # of required central controllers is: (1,025 sites - (11 sites/simulcast cell x 9 simulcast cells) + 9 simulcast cells)/48 cells/central controller, or 20. For redundancy, the twenty is doubled resulting in 40 central controllers being required.
5. For 700/800 MHz system, assume as minimum: 2 simulcast systems along coast between San Diego and Orange County, 2 in L.A., 1 in San Bernardino County, 1 in San Francisco/San Mateo Counties, 1 in Contra Costa County, 1 in Alameda/Santa Clara Counties, and 1 in Sacramento County. For VHF High-Band, assume as a minimum: 1 simulcast system along coast between San Diego and Orange Counties, 1 in L.A. County, 1 in San Francisco/San Mateo Counties, and 1 in Contra Costa County.
6. Reflects the number of individual systems associated with that Department. For example, 42 systems to support CDC's 33 institutions.
7. Value is "0" if system is conventional. If trunked, the required number of remote controllers is based on the required number of Department specific sites minus one-half the number of Department specific central controllers.
8. Initial assumption that CHP and DOT will require 4 channels per site, CDC will require less than 3 channels per site (approx. 2.4), and all other Departments will require 3 channels per site. The control channel is included in this assumption.
9. Initial assumption that CHP will require an average of 1.5 channels per site; other Departments will require an average of 1 channel per site.
10. Assumes the existing 250 state microwave paths will be converted to digital paths outside of this contract. Further assumes a percentage of the sites without state microwave connectivity will be provided with digital microwave paths under this contract, and the remainder will be provided with T-1 (or better) circuits. The indicated estimate of new paths was derived by assuming 29% of the new sites without state microwave connectivity will not have access to telephone company T-1 (or better) circuits.
11. Assumes that 71% of the new sites could not be accommodated by microwave paths, i.e., 71% of the new sites not connected by state microwave paths are recipients of Telco T-1 (or better) circuits.
12. Lease costs over and above those already incurred through current lease arrangements are taken into account in this line item. There are 377 suitable, existing state radio communications sites for which leases exist. Technology advancements have, to some degree, reduced the per-channel rack space requirements of new radio communications systems. Operating in higher frequency ranges also results in rack space reductions due to smaller combiner cavities. However, the existing space requirements may not be adequate, leading to additional lease fees. The calculation assumes that space requirements in 25% of the existing 377 sites will result in increased (new) leasing costs. It also assumes that all the additional (new) sites will result in (new) leasing costs.

APPENDIX E

GLOSSARY

THE WARNER GROUP

Agency	***Agency*** – Agency is a term used throughout the document when referring to State organizations. This term is used interchangeably with the term "Department" throughout the document.
APCO	***Association of Public-Safety Communications Officials*** – APCO is a group that follows spectrum issues and gives voice to issues and concerns related to public safety.
AVL	***Automatic Vehicle Location*** – AVL is a technology that allows managers to track vehicle resources to enable quicker response times. AVL is sometimes associated with Global Positioning Satellite (GPS).
Backbone	***Backbone*** – This term is used to imply fixed site radio equipment (including microwave). The term "infrastructure" is also used to represent this same concept.
bps	***Bits per second –*** The amount of data transferred in a single transmission is measured by the amount of digital "bits" of information that are sent in a single second.
BCP	***Budget Change Proposal*** – A BCP is the tool that State departments use to request budget funds once the State budget is set for the fiscal year. The BCPs described in this document are reflective of the proposals set forth for Fiscal Year 1997/1998. The document is meant to show a "snapshot" in time, and the description of current systems implies the systems that were in use at the time the document was written.
CAD	***Computer Aided Dispatch –*** This document only address wireless communications systems. CAD systems are not discussed in this document beyond a mention that they are not applicable to this Cost/Benefit Analysis.
CALCORD	***California-On-Scene Emergency Coordination System*** – One of the statewide mutual aid channels.
CAP	***Civil Air Patrol*** – The CAP is a civilian arm of the United States military, and can be mobilized in a time of crisis. CAP provides mutual aid support and medical transportation support for emergency situations.
CDC	***California Department of Corrections*** – CDC is one of the ten participating State public safety organizations. CDC is the largest radio user in the State.

CDF	***California Department of Forestry and Fire Protection*** – CDF is one of the ten participating State public safety organizations.
CDMA	***Code Division Multiple Access*** – CDMA is one of the voice technologies that was studied for the analysis of alternatives. CDMA is a technology associated with the concept of spread spectrum.
CDPD	***Cellular Digital Packet Data –*** CDPD is a technology in which data information is transmitted in digital streams of "packet" information. It utilizes existing cellular infrastructure and is subject to the same coverage limitations as is cellular telephone. CDPD is one of the mobile data technologies that were studied for the analysis of alternatives.
CESRS	***California Emergency Services Radio System*** – One of the statewide mutual aid channels.
CHP	***California Highway Patrol*** – CHP is one of the ten participating State public safety organizations.
CLEMARS	***California Law Enforcement Mutual Aids Radio System*** – One of the statewide mutual aid channels.
CLERS	***California Law Enforcement Radio System*** – One of the statewide mutual aid channels.
CMARS	***California Multiple Agency Radio System*** – One of the statewide mutual aid channels.
CSC	***Circuit Switched Cellular*** – CSC is a mobile data technology based on the same concept as cellular voice communications, and is limited by the same coverage restrictions as is cellular telephone service. CSC is one of the mobile data technologies that were studied for the analysis of alternatives.
CTSU	***Cellular Telephone System Use*** – CTSU is simply the use of cellular telephones in place of radio units. CTSU is one of the voice technologies that were studied for the analysis of alternatives.
CYA	***California Department of the Youth Authority*** – CYA is one of the ten participating State public safety organizations.
Department	***Department*** – Department is a term used throughout the document when referring to the participating State public safety/ public service organizations. This term is used interchangeably with the term "Agency" throughout the document.

DFG	***Department of Fish and Game*** – DFG is one of the ten participating State public safety organizations.
DGS	***Department of General Services*** – DGS is the State organization that provides the technical support for State telecommunications systems.
DOJ	***Department of Justice*** – DOJ is one of the ten participating State public safety organizations.
DOT	***Department of Transportation*** – DOT (CalTrans) is one of the ten participating State public service organizations.
DMDN	***Dedicated Mobile Data Network*** – A DMDN would only support mobile data communications for the State, and would not support other types of communications (e.g. voice communications). This is one of the technical options for mobile data that was studied for the analysis of alternatives.
DPR	***Department of Parks and Recreation*** – DPR is one of the ten participating State public safety organizations.
DWR	***Department of Water Resources*** – DWR is one of the ten participating State public safety organizations.
E-Paging	***Enhanced Paging*** – E-Paging is one of the mobile data technologies that were studied for the analysis of alternatives.
ESMR	***Enhanced Specialized Mobile Radio*** – SMR is a commercially supported means of providing communications, and can be used for voice or data communications. ESMR is one of the mobile data technologies that were studied for the analysis of alternatives.
FCC	***Federal Communications Commission*** – The FCC is the governing regulatory body for State and local level use of radio frequencies. It is the FCC that sets the rules and guidelines for licensing and use of radio frequencies.
FDMA	***Frequency Division Multiple Access*** - FDMA is one of the voice technologies that were studied for the analysis of alternatives. FDMA is a technology that separates trunked radio channels by dividing transmissions into the bandwidth previously assigned to a single channel, thus creating space for many channels where before there was only space for one channel.
Fixed Equipment	***Fixed Equipment*** – Fixed equipment is defined as remote radio site equipment (mountain top repeaters, etc.). It is this equipment that is considered as part of the system backbone (or infrastructure).

GHz	***Gigahertz –*** One billion cycles per second. Hertz is the unit in which frequency is measured. The number of cycles a particular wavelength will oscillate in a single second tells us the frequency of that wavelength. Typical public safety frequencies are listed at VHF (20-50, and 150-174 MHz), UHF (450-470 MHz), UHF-T (470-512 MHz), and 800 MHz. An example of a user that operates in the Gigahertz range is PCS, which operates at approximately 2 GHz.
GEO	***Geo-Stationary Earth Orbit Satellite*** – GEO satellites provide communications coverage with a single, very high altitude satellite. GEO satellite is one of the voice radio technologies that were studied for the analysis of alternatives.
GOES	***Geo-Stationary Operational Environmental Satellite*** – GOES provides a mutual aid option for State departments equipped with the required satellite terminals. OES is a prominent user of GOES.
Infrastructure	***Infrastructure*** – This term is used to imply fixed site radio equipment (including microwave). The term "backbone" is also used to represent this same concept.
IVDN	***Integrated Voice and Data Network*** – An IVDN would support both voice and data communications. IVDN is one of the mobile data technologies that were studied for the analysis of alternatives.
kbps	***Kilo-bits per second*** – One thousand bits per second. The amount of data transferred in a single transmission is measured in the amount of digital "bits" of information that are sent in a single second of time.
kHz	***Kilohertz*** – One thousand Hertz. Hertz is the unit in which frequency is measured. The number of cycles a particular wavelength will oscillate in a single second tells us the frequency of that wavelength. Typical public safety frequencies are listed at VHF (20-50, and 150-174 MHz), UHF (450-470 MHz), UHF-T (470-512 MHz), and 800 MHz.
LEO	***Low Earth Orbit Satellite*** – LEO satellite systems are comprised of constellations of several lower altitude satellites. LEOs are a new technology, and are only now "coming on-line". LEO satellite is one of the voice radio technologies that were studied for the analysis of alternatives.
MARS	***Multi-agency Radio System*** – One of the statewide mutual aid channels.

MDC	***Mobile Data Computer*** – MDCs are basically laptop computers that are mounted into vehicles. MDC is one of the mobile data technologies that were studied for the analysis of alternatives.
MDT	***Mobile Data Terminal*** – MDTs are devices with limited processing capabilities, and are basically "dumb" terminals limited to pre-formatted messaging and other similar types of transmissions. MDT is one of the mobile data technologies that were studied for the analysis of alternatives.
MHz	***Megahertz*** - One million cycles per second. Hertz is the unit in which frequency is measured. The number of cycles a particular wavelength will oscillate in a single second tells us the frequency of that wavelength. Typical public safety frequencies are listed at VHF (20-50, and 150-174 MHz), UHF (450-470 MHz), UHF-T (470-512 MHz), and 800 MHz.
Mobile Equipment	***Mobile Equipment*** – Mobile equipment is defined as radio equipment that is vehicle mounted.
MST	***Mobile Status Terminal*** – MSTs provide even less capability than do MDTs (see MDT above). MST is one of the mobile data technologies that were studied for he analysis of alternatives.
NALEMARS	***National Law Enforcement Mutual Aid Radio System*** – Nationwide mutual aid channel.
NCIC	***National Crime Information Computer*** – NCIC is a resource for law enforcement agencies throughout the country. The new initiative, NCIC 2000, will make digital information such as fingerprints, mugshots, etc. available to mobile data users nationwide.
NPSPAC	***National Public Safety Planning and Advisory Committee*** – NPSPAC is an organization that identified a critical need for additional public safety spectrum and lobbied for allocations from the FCC. The FCC allocated several channels in the upper 800 MHz band (866-869 MHz) that are now designated as NPSPAC frequencies.
NTIA	***National Telecommunications Information Administration*** – The NTIA is the governing regulatory body for federal level use of radio frequencies. It is the NTIA that sets the rules and guidelines for licensing and use of radio frequencies for all federal radio users.
OASIS	***Operational Area Satellite Information System*** - OASIS provides a mutual aid option for State departments equipped with the required satellite terminals. OES is a prominent user of OASIS.

OES ***Office of Emergency Services*** – OES is one of the ten participating State public safety organizations.

PCS ***Personal Communication System*** – PCS is one of the mobile data technologies that were studied for the analysis of alternatives.

PDD ***Portable Data Device*** – PDD is one of the mobile data technologies that were studied for the analysis of alternatives. An example of a PDD is the hand held devices used at rental car check-in.

Portable Equipment ***Portable Equipment*** – Portable equipment is defined as radio equipment that is hand-held.

PPRN ***Private Packet Radio Networks*** – PPRN is one of the mobile data technologies that were studied for the analysis of alternatives. It is somewhat similar to CDPD.

PSAP ***Public Safety Answering Point*** – A PSAP is the telephone answering point for incoming 9-1-1 and E9-1-1 emergency calls.

PSTN ***Public Switched Telephone Network*** – The PSTN provides the landline connection for all telephone calls. This includes telephone calls originated from wired telephones, cellular telephones, and radios (mobile or portable).

PSWAC ***Public Safety Wireless Advisory Committee*** – The PSWAC is an organization that was formed to study the amount of spectrum allocated for use by public safety organizations. The PSWAC determined that there is a critical shortage of public safety radio frequency allocations, and has strongly lobbied the FCC to allocate additional spectrum for use by public safety organizations.

RACES ***Radio Amateur Civil Emergency Service*** – RACES is to radio what the Civil Air Patrol is flying. It is a class of radio service for civilian, amateur radio operators, which contribute to mutual aid operations during times of crisis.

SMARS ***Statewide Mutual Aid Radio System*** – One of the statewide mutual aid channels.

SMD ***Satellite Mobile Data*** – SMD is one of the mobile data technologies that were studied for the analysis of alternatives.

SMR ***Specialized Mobile Radio*** – SMR is a commercially provided communications network. SMR is one of the technologies that was studied for the both voice radio and mobile data for the analysis of alternatives.

SSB ***Single Side-Band*** – SSB is one of the voice radio technologies that were studied for the analysis of alternatives. It is not a widely used technology, and although it is spectrally efficient, it is not a particularly viable solution for public safety agencies as its limited use would impair agency interoperability.

TDMA ***Time Division Multiple Access*** – TDMA is one of the voice technologies that was studied for the analysis of alternatives. TDMA is a technology that separates trunked radio channels by dividing transmissions into a single unit of time, thus creating space for many channels where before there was only space for one channel.

UHF ***Ultra-High Frequency*** – UHF (406-869 MHz) is one of the frequency bands that was studied for the analysis of alternatives.

UHF-T ***Ultra-High Frequency Television Band*** – UHF-T (470-512 MHz) is one of the frequency bands that was studied for the analysis of alternatives.

USFS ***United States Forest Service*** – USFS is a federal agency with which CDF conducts a great deal of mutual aid operations. USFS operates in the VHF High-Band, thus it is important for CDF to remain in this same frequency band for its primary means of communication.

VHF ***Very High Frequency*** – VHF (Low-Band, 20-50 MHz; High-Band 138-174 MHz) is one of the frequency bands that were studied for the analysis of alternatives.

800 MHz ***800 MHz*** – Although this portion of the spectrum is considered to be "UHF" spectrum, it is often designated simply as the "800 MHz band." Initial allocations for local government public safety organizations were made at 806-809 MHz, and subsequent allocations, designated as NPSPAC channels, were made at 821-824/866-869 MHz.